YIELD OF ULTRASOUND GUIDED FNAC IN NON RESOLVING LUNG CONSOLIDATION IN TEACHING MEDICAL COLLEGE HOSPITAL, TIRUNELVELI

A STUDY OF 62 CASES

DISSERTATION SUBMITTED FOR THE DEGREE OF DOCTOR OF MEDICINE

DEPARTMENT OF CHEST MEDICINE

BRANCH – XVII (TUBERCULOSIS AND RESPIRATORY MEDICINE)

APRIL 2016

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY,

CHENNAI

DEAN CERTIFICATE

This is to certify that the dissertation entitled **"YIELD OF ULTRASOUND GUIDED FNAC IN NON RESOLVING LUNG CONSOLIDATION IN TEACHING MEDICAL COLLEGE HOSPITAL, TIRUNELVELI"** submitted by **Dr.O.M. MOHIDEEN HAJI** , in partial fulfillment for the award of the degree of Doctor of Medicine in TUBERCULOSIS AND RESPIRATORY MEDICINE by theTamilnadu Dr.M.G.R. Medical University, Chennai , this is a bonafide original research work done by him in the department of **TUBERCULOSIS AND RESPIRATORY MEDICINE**, Tirunelveli Medical College, under the guidance and supervision of **Prof.Dr.K.KRISHNAMOORTHY,M.D.** during the academic year 2013-2016.

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ACKNOWLEDGEMENT

I am extremely thankful to **DR.SITHY ATHIYA MUNAVARA M.D., Dean,** Tirunelveli Medical College, for his permission to carry out this study.

I am immensely grateful to **Prof.Dr.K.KRISHNAMOORTHY M.D.,** Professor and Head of the Department, Department of CHEST MEDICINE, for his concern and support in conducting the study.

I am very grateful to **Prof. Dr.G.SANGAMITHRA., M.D, Associate Professor Kanyakumari Medical College, Kanyakumari** for their constant motivation and valuable suggestions.

I am greatly indebted to my co-guide **Dr.O.M.RAHMAN SHAHUL HAMEED ., DTCD., & Dr.P. SENTHIL ARASU., DTCD.DNB,** for his inspiration, guidance, and comments on all stages of this study.

I am very grateful to Professor., **DR. SANTHARAM., H.O.D., DEPARMENT OF PATHOLOGY., DR. NANCY DORA., H.O.D., DEPARTMENT OF RADIOLOGY.,** for their constant guidance.

I am thankful to **Dr. C. BASKAR.,** DR-TB M.O., and Dr. **T.NATARAJAN**., T.B.CELL M.O., for their guidance and help.

I am thankful to **Mrs. SUNDARI ., H.V., & Mrs. P.KANNAMMAL., SA/DEO** for their immense help for finishing my desertation.

I am thankful to all my colleagues for the help rendered in carrying out this dissertation.

I thank all the patients for willingly submitting themselves for this study.

I whole heartedly thank my partner **Dr. AJEEMA.M.B.B.S., and my father Mr.MOHAMED EHIYA and my mother Mrs.AMEENAL BEEVI** for their constant encouragement.

ABBREVIATIONS

AFB –acid fast bacilli

ATS-American Thoracic Society

BOOP- Bronchiolitis obliterans

Organizing pneumonia

BTS- british thoracic society

BAC-Bronchialveolar carcinoma

CAP-community acquired pneumonia

COP-cryptogenic organizing pneumonia

COPD-chronic obstructive

Pulmonary disease

CT-Computed tomography

CXR-chest radiograph

FNAC-Fine needle aspiration cytology

HIV-human immunodeficiency virus

IDSA-infectious disease society of America

LRI-Lower respiratory infection

MDR-multidrug resistance

NPV-Negative predictive value

PCP-Polymerase chain reaction

PPV-Positive predictive value

RR-Respiratory rate

USG-Ultrasound

received an empirical course of antibiotics as suggested by American Thoracic Society guidelines.

INCLUSION CRITERIA

1. **PATIENTS WHO FULFILL THE DIAGNOSIS OF NON-RESOLVING PNEUMONIA(NO RADIOLOGICAL RESOLUTION AFTER 4 WEEKS OF ANTIBIOTICS)**
2. **SPUTUM CULTURE NEGATIVE AND SPUTUM FOR AFB NEGATIVE**
3. **HIGH CLINICAL AND RADIOLOGICAL SUSPICION OF LUNG CARCINOMA**

EXCLUSION CRITERIA

1. **KNOWN PATIENTS OF LUNG CANCER**
2. **SPUTUM-POSITIVE PULMONARY TUBERCULOSIS**
3. **PATIENTS HAVING VERY POOR GENERAL CONDITION, VERY SEVERE BREATHLESSNESS, RECENT HISTORY OF MYOCARDIAL INFARCTION.**
4. **POSITIVE TEST RESULT FOR HUMAN IMMUNODEFICIENCY VIRUS(HIV) INFECTION**
5. **UNWILLING PATIENTS WERE OMITTED FROM OUR STUDY.**

STUDY PROTOCOL:

Clinical, radiological and laboratory tests were performed before initiating empirical antibiotics, and after they fail to improve after antibiotic therapy. A STRUCTURED PROFORMA was used.Patients age,sex and smoking history if present were noted.Prior investigations,sputum for AFB,sputum culture report and HIV reports were noted down .proper consent was obtained from the patients after procedure was explained in their local language and consent form duly signed in their local language.All patients who were included in the study were hospitalized for a day to look for complication such pneumothorax and bleeding.Chest x-ray were done 6 hours after the procedure.Standard operating procedure for managing PNEUMOTHORAX was fixed according to British Thoracic society guidelines.Investigations done in this study after labelling the patient as patient with non resolving pneumonia were ultrasound guided FNAC done with 21gauge needle and bronchoscopic wash culture and cytology and biopsy if warranted.

INSTRUMENTATION:

ULTRASOUND LT200 MODEL WITH CURVILINEAR PROBE WITH FREQUENCY OF

3.5MHZ TO 5MHZ WAS USED BY THE **PULMONOGIST**and chest medicine postgraduates who were trained in handling ultrasound.10 ml syringe with 21 gauge needle was used for FNA and smear slides were air dried and sent to pathology

department.Bronchoscopy was done using Olympus fibre optic bronchoscope and specimen were collected under standard norms and sent for culture and histopathology.

INTRODUCTION

Pneumonia is a common respiratory disorder,which affects all age groups. It is the of leading cause of mortality especially among children and causing significant morbidity in adults if left untreated. It is leading cause of disability adjusted life years worldwide. Epidemiology of pneumonia differs among children and adults and so understanding causes and risk factors is very essential for proper diagnosis and treatment. Prevalence and incidence of pneumonia vary according to geographical distribution and seasonal pattern also. The burden of pneumonia is well illustrated by the quote of William Osler who described the disease as the CAPTAIN OF THE MEN OF DEATH.

Pneumonia is common in children aged less than 5 years and becomes progressively more common from 40 years onwards with peak incidence in the very elderly. Pneumonia can affect previously healthy individuals, but susceptibility is greatly increased by a variety of risk factors(I). This distribution is the result of a complex interrelationship between environment, host and socio economic factors. South east Asian WHO region has a death of 8 per 10000 due to pneumonia. There is a male dominance in the deaths due to pneumonia and highest incidences at extremes of ages.

PNEUMONIA IS DEFINED AS INFLAMMATION OF ONE OR BOTH LUNG PARENCHYMA WITH CONSOLIDATION. Cause is mainly infective but consolidation can be occur due irritant gases, radiation, allergens, malignancy. Community acquired pneumonia (CAP) is a leading cause of hospital admission. The micro organisms giving rise to CAP may show geographical variation, however, in general both bacteria and viruses are responsible.

Classification based on the site of acquisition is important as the responsible organisms varies according to where it was acquired. The etiological agent of community acquired pneumonia is an important factor for predicting the disease severity and the level of care warrented. Pneumococcus and multiorganism infection are the most common causes warranting treatment in an intensive care unit in CAP.

COMMON CAUSES IDENTIFIED INCLUDES:

- BACTERIA: *S. pneumoniae, H. influenzae,* Methicillin sensitive Staph aureus, *E. coli, Klebsiella pneumoniae, Proteus* sp., *Enterobacter* sp., *Serratia marcescens.*
- Respiratory viruses = Influenza A and B viruses, adenoviruses, respiratory syncytial viruses, parainfluenza viruses
- Mycoplasma
- Chlamydia

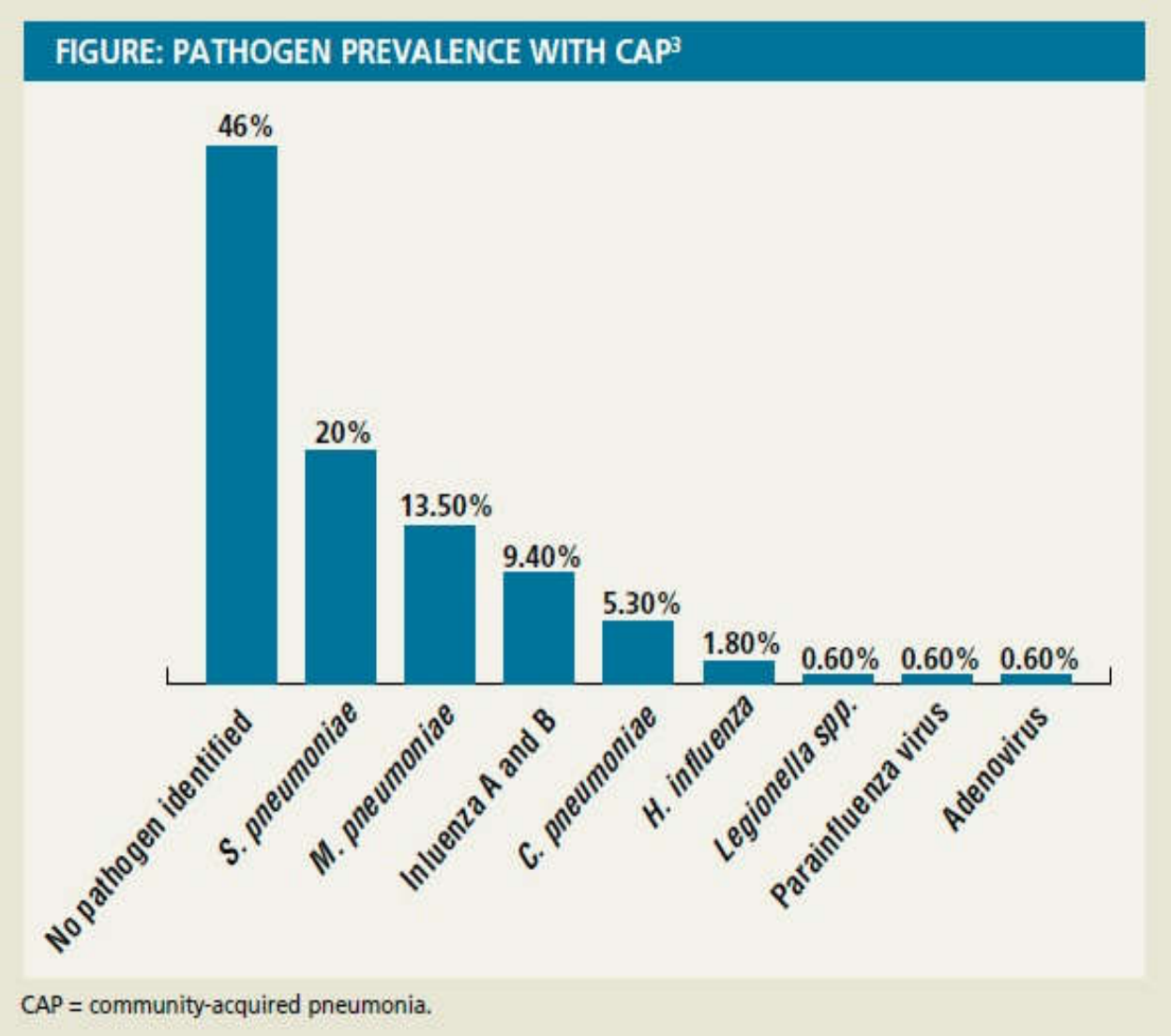


Figure 1:COMMON CAUSES OF CAP

Risk Factors

Causative organisms from the upper airways or less commonly from hematogenous spread or direct spread from a contiguous focus find their way to lung parenchyma. Conditions such as altered sensorium, stroke facilitate aspiration of contents into lungs. Loss of upper airway reflexes such cough, impairment of local defence mechanism such as mucosal blanket which is lost due smoking and irritants ,factors that destroy alveolar epithelium such tobacco smoking, bronchial metaplasia or neoplasia, pulmonary edema and congenital causes such primary ciliary dyskinesia contribute to pneumonia

Pathogenesis

Causative agents commonly enter the respiratory tract but, because of innate defense mechanisms, do not normally cause pneumonia. When pneumonia occur, it usually is the result of an virulent microbe, a large “dose” of bacteria, and/or impaired host defense which includes alveolar macrophage is capable of removing most infectious agents and multiple chemical mediators of inflammation, infiltration of white blood cells.

In non-hospitalized people,causative agent reach the lung by one of four routes:

- Inhalation when an infected individual coughs or sneezes
- Micro aspiration from the upper airways
- Spread from contiguous infected sites
- Hematogenous spread

Once the pathogen or agent enters the bronchi and bronchioles, it firmly fixes with the wall and causes cascade of inflammation in the host body. There are two main types of acute pneumonia : bronchopneumonia (with lobular topography) and lobar pneumonia (lobar topography). Lobar pneumonia causes exudative inflammation of an entire pulmonary lobe. If not treated, lobar pneumonia evolves in four stages. Common to all stages is the enlargement of the affected lobe with loss of its spongy appearance

Radiological findings of pneumonia are airspace opacity, lobar consolidation, or interstitial opacities. There is usually considerable overlap. Pneumonias is a space occupying lesion without volume loss. Major differentiating factors between atelectasis and pneumonia are in pneumonic consolidation there is no volume loss ,no mediastinal or tracheal shift. Lung mass and consolidation are hard to differentiate since air bronchogram is seen in only 30% of consolidation.

Chest X-Ray Patterns In Different Types Of Pneumonia

- **Lobar pattern**- classical of Pneumococcal pneumonia. entire lobe appear consolidated and air bronchograms are common
- **Lobular pattern(bronchopneumonia**) – often seen Staph aureus. Multifocal, patchy, sometimes without air bronchograms
- **Interstitial pattern** - Viral or Mycoplasma; initially shadows seen in perihilar and can become confluent and/or patchy as disease progresses. There will be no air bronchograms
- **Cavity formation** :Mycobacterium tuberculosis, S. aureus, gram-negative bacilli

Figure 2 Lobar pneumonia due to *Streptococcus pneumoniae.* Posteroanterior (A) and lateral (B) chest radiographs show extensive right middle lobe consolidation.

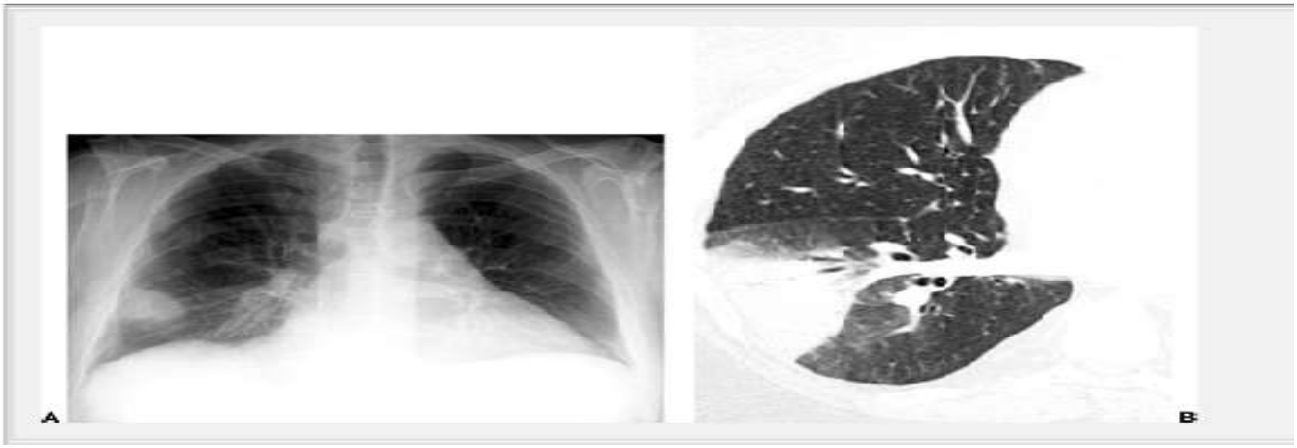


Figure 3: Round pneumonia. A: Anteroposterior chest radiograph shows a sharply defined rounded opacity in the right lower lung zone. B: Computed tomography (C T) image (5-mm collimation) demonstrates mass-like right lower lobe consolidation

Management lies on four important facts:

- Pneumonia usually has largely non-specific clinical features
- It can be caused by more than 100 different pathogens and agents
- no strong relationship exist between specific clinical features and causative agent to allow a clinical diagnosis of the causative organism
- early administration of appropriate antibiotics is very important

No clinical study exists to show that management directed to a specific pathogen is statistically superior to empirical therapy(1). Therefore, most CAP patients are treated empirically .Because most cases of pneumonias are caused by bacteria, treatment usually involves antibiotic therapy.

- For patients with no co morbid condition and CURB-65 Score less than or equal to 1,drugs includes a macrolide (azithromycin or clarithromycin) in outpatient department. In patients with comorbid illness such diabetes, immunosuppressive drugs and asplenia a fluroquinolone such moxifloxocin should be used.b-lactam antibioticplus a macrolide must be used

- For hospitalized patients on the general wards, the IDSA/ATS guidelines recommend an antipneumococcal fluoroquinolone (eg, levofloxacin, moxifloxacin) or the combination of a beta-lactam plus a macrolide
- For patients with severe CAP requiring intensive care unit (ICU) admission, the IDSA/ATS guidelines(6) recommend a beta-lactam (ceftriaxone, cefotaxime, ampicillin-sulbactam) plus

either intravenous azithromycin or an anti pneumococcal fluoroquinolone. If *Pseudomonas* is a concern, an antipseudomonal agent (piperacillin-tazobactam, imipenem, meropenem, or cefepime) PLUS an antipseudomonal fluoroquinolone (ciprofloxacin or high-dose levofloxacin) should be used. If MRSA is a concern, either vancomycin or linezolid should be added

MONITORING CLINICAL OUTCOME

In about one half of pneumonia patients, the etiologic agents are undetermined and if the agent is known, more definitive therapy can be initiated. Patients usually should have subjective improvement within 3 to 5 days of antibiotic therapy. Tachypnea, fever, and oxygen saturation improve within three days. Cough and fatigue, which may take 2 weeks or more to subside.

In immune competent patients who present with classical CAP (i.e., fever, chills, productive cough, new pulmonary infiltrate), clinical response to therapy is the most important determinant for further diagnostic studies. Within the first few days, persistence or even progression of infiltrates on chest radiographs is not unusual. Given the wide variation in radiographic clearance, it remains controversial to decide when to initiate an invasive diagnostic work-up for non resolving or slowly resolving pulmonary infiltrates. Nevertheless aggressive approach is also warranted in patients who are clinically stable or improving when the rate of radiographic resolution is prolonged

During the clinical course of a CAP patient, different time interval can be selected for evaluation of outcome. Clinical outcome can be evaluated at the time of hospital discharge. At this point, the patient with improvement of infection can be classified as clinical success, and the patient who died during hospitalization is classified as clinical failure. Evaluation of

patient outcome at the time of hospital discharge is the simple way to evaluate and document clinical outcome.

Based on clinical response to antibiotic therapy, the clinical outcome of CAP patients can be categorized by day 7 of hospitalization into patients with early clinical response (group 1 of Figure 4), patients with late clinical response (group 2 of Figure 4), patients with early clinical deterioration (group 3 of Figure 4), patients with late clinical deterioration (group 4 of Figure 4), and patients with non resolving CAP (group 5 of Figure 4)

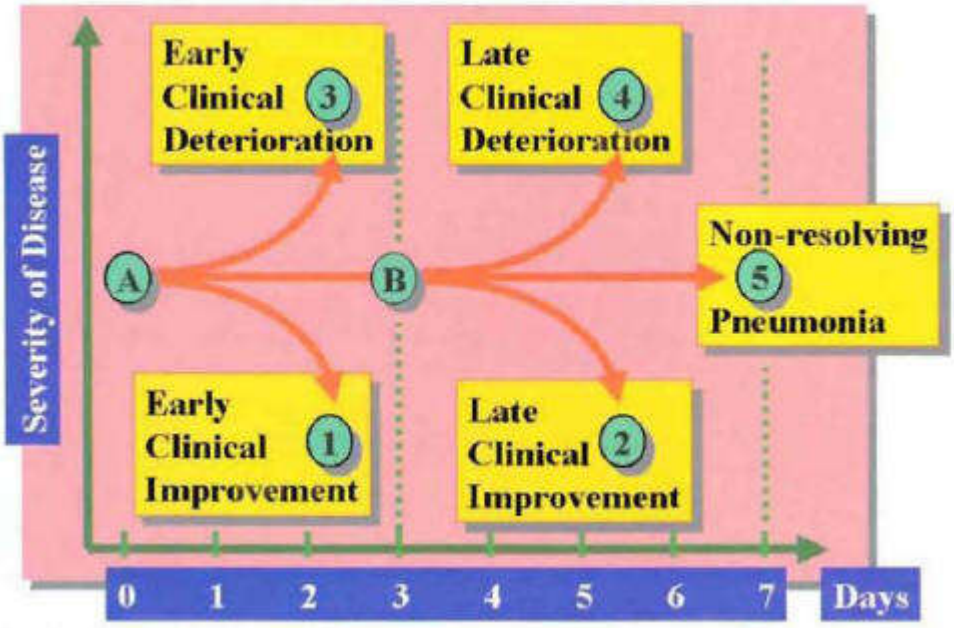


Figure 4:Progression of CAP-

In patients with a correct diagnosis, the clinical deterioration can be classified in two groups:

- one group of patients with deterioration owing to inappropriate antimicrobial therapy,
- second group of patients with clinical deterioration even with appropriate antimicrobial therapy

Another reason for failure of treatment in hospitalized patients with diagnosis of CAP is that the **clinical diagnosis of pneumonia was incorrect** .Some examples of clinical diagnosis that may be confused initially with CAP include obstructing bronchogenic carcinoma, lymphoma, intrapulmonary bleeding, bronchiolitis obliterans organizing pneumonia, and drug-induced pulmonary disease (e.g., amiodarone). A patient diagnosed with a noninfectious illness should be excluded from clinical outcome evaluation.

REVIEW OF LITERATURE

NON RESOLVING PNEUMONIA

Delay in resolution of community-acquired pneumonia (CAP) is a common clinical outcome a pulmonologist encounter in daily clinics. Mittl and colleagues demonstrated that only half of patients with community acquired pneumonia have radiographic resolution at two weeks .Non resolving pneumonia or Slow resolving pneumonia or chronic pneumonia are arbitrary and not interchangeable to some extent .Some investigators focus on radiological abnormalities and others focus on acute/chronic and systemic abnormalities such as cough, malaise.

Definition for slow resolving pneumonia includes:

- less than complete clearance of radiological infiltrates in 4 weeks
- less than 50% clearance in chest infiltrates in patients who are defervesed and improved symptomatically
- non resolution of radiological infiltrates in an expected period of time based on presumptivediagnosis and atleast 10 days of antibiotics

Another ***definition*** endorsed by the Infectious Disease Society of North America is fairly vague- "a situation in which an inadequate clinical response is present despite antibiotic treatment". As in many things, clinical judgment is paramount – considering ongoing cough with sputum production, clinical status, LOW SATURATION and WBC count

Failure to improve after antimicrobial treatment is usually associated with the presence of advanced age, comorbidity, resistant pathogens, complication of pneumonic process or inadequate antimicrobial selection . Clearance was slower in smokers and those treated as outpatients .However, some noninfectious or unusual infectious diseases have a similar clinical, radiological and lab characteristics of CAP. This may represent a clinical challenge to the physician, especially because diseases that mimic CAP usually are only considered in the differential diagnosis after treatment failure.

Wrong interpretation leads to unnecessary investigations, procedure further complicating the clinical course. As non resolving pneumonia or slow resolving pneumonia encountered rarely as compared to more common CAP diagnosis usually warrants more invasive strategies. The late diagnosis often results in unwanted antibiotic therapy causing undue financial strain for the patient(3).

OTHER DEFINITIONS FOR NON RESOLVING PNEUMONIA

Non resolving pneumonia is a clinical syndrome in which focal infiltrates begin with some clinical association of acute inflammation and despite minimum of 10 days antibiotics patient either dont improve or worsen or radiographic opacities fail to resolve within 12 weeks- J am GERIATR society 04(5)

Treatment failure: Assessed 72 h after the beginning of the treatment, included at least one of the following: persistence of fever (⩾38°C) or hypothermia (<35.5°C) plus purulent respiratory secretions; worsening of the pulmonary infiltrate by >50%; occurrence of septic shock [5] or multiple organ dysfunction syndrome (MODS) [6] not present on the onset.

Unusual infection: Isolation of an uncommon pathogen (e.g. fungus, tuberculosis) that do not respond to usual antimicrobial treatment.

Mimic of pneumonia: Defined when pulmonary infiltrates and clinical symptoms of lower respiratory tract infection were attributed to a different diagnosis, other than pneumonia

Possible etiologies are many and include both infectious and non-infectious causes. Important things to consider are:

- Time of treatment - Patients treated less than 72 hrs should be considered as inadequate treatment time.
- Infectious Causes - Consider a pathogen not covered by your treatment (e.g. tuberculosis, non-tuberculous mycobateria, viral or fungal infections) or a resistant organism (e.g. MRSA pneumonia).
- Non-Infectious Causes - malignancy, interstitial lung disease, heart failure.

British Medical journal published an article enumerating causes of persistent lung lesions (table 1). Journal described complications such as empyema, parapneumonic effusion, lung abscess, host factors which includes age>60, comorbid illness, smoking, malnutrition, presence of drug resistant organisms such drug resistant S.pneumoniae, MRSA, unusual pathogens such as Atypical mycobacteria, nocardia, actinomycosis, pneumocystis jerovici,fungal infection such as aspergillosis, histoplasmosis, cryptococcis, coccidiodes and hanta virus, diseases that mimics pneumonic consolidation such lung carcinoma, bronchiolitis obliterans organizing pneumonia, systemic vasculitis such wengenerrs granulomatosis, eosinophilic pneumonia, insterstial pulmonary fibrosis, non cardiogenic pulmonary edema, hypersensitivity pneumonitis, radiation pneumonitis, occupational diseases,alveolar proteinosis and lesions with slow radiological recovery which is due to extent of pneumonic consolidation such as extensive lobar pneumonia and bilateral pneumonia and level of bacteremia. History of travel is also very important in excluding causes pertaining to that region. Patients immune status should also be assessed since opportunistic infection are more common. History regarding rearing of pet animal such as dogs and cat should be enquired to rule out psittacosis.

Table 1: causes of non-resolving pneumonia

Causes of non-resolving pneumonia	
Complications	• Empyema/parapneumonic effusion, abscess • Metastatic infection (e.g., infective endocarditis).
Host factors	• Age >60 years • Co-morbid illnesses (COPD, congestive heart failure, diabetes, renal failure, alcoholism) • Smoking • Defects in defense (immunosuppressive/cytotoxic therapy, use of feeding tube, endotracheal tube, tracheostomy or sedating drugs) • Malnutrition.
Presence of resistant organisms	**Drug-resistant *Streptococcus pneumoniae*** suspected if: • Treated with beta lactams within 6 months • Close exposure to young children • Pneumonia in last 1 year • Hospitalised in last 3 months - HAP in last 2 months **Methicillin-resistant *Staphylococcus aureus* (MRSA)** suspected if: • Advanced age • Prior antibiotic coverage, indwelling IV catheters, tertiary care centres, dialysis • Burns, surgical wounds • Gingivitis, risk of loss of consciousness (seizures or alcohol abuse, oesophageal motility disorders). **CAP:** especially *S pneumoniae*, *S aureus* **Nosocomial pneumonia:** especially MRSA, *Pseudomonas aeruginosa*, *Acinetobacter*
Presence of unusual organisms	• Tuberculosis, atypical mycobacteria • *Nocardia*, *Actinomyces* • *Pneumocystis jiroveci* • Fungi: *Aspergillus*, *Cryptococcus*, *Histoplasma*, *Coccidioides*, *Mucor* • Exposure to animals: *Francisella tularensis*, *Coxiella burnetii*, *Chlamydophila psittaci* • Travel to endemic areas: *Coccidioides* species, Hantavirus, paragonimiasis.
Delayed radiological recovery	• Extent of disease: multilobar or bilateral pneumonia, pleural effusion, bacteraemia • Causal micro-organism (**see table below**).
Diseases mimicking pneumonia	Malignancy, systemic vasculitis, connective tissue disorders, cardiogenic pulmonary oedema, eosinophilic pneumonia, hypersensitivity pneumonia, OP, IPF, alveolar proteinosis, drug-induced, occupational lung disease, lipoid pneumonitis, radiation pneumonitis.

DIAGNOSTIC DILEMMAS

The diagnosis of mimics may be delayed for FOLLOWING reasons:

1. Wrong clinical assessment (fever, cough, respiratory secretion and pulmonary infiltrates)
2. Empirical therapy lacking broad spectrum coverage
3. Obtaining late investigation

4. Lack of knowledge of pneumonia mimics
5. Not using invasive diagnostic modalities

A good detail clinical history helps to clinch the diagnosis .diseases like tuberculosis shows endemicity and geographical characteristics. Some diseases occur affecting two or more system in our body along with lung pathology. Patient ‘s personal history such as smoking, alcohol consumption and occupation should be noted.

Investigations available:

1. Blood testing
2. Serological testing
3. Culture methods
4. Radiological modalities
5. Bronchoscopy
6. USG or CT guided aspirations and biopsy

There cannot be a single algorithm to find out all possible etiologies in non resolving pneumonia. All these modalities should be selected based on case preference in evaluating non resolving pneumonia taking into account patient’s clinical and economical background. Cultures methods should be repeated since the culture performed initially and after a month will show marked variation. Microbes with prolong generation time and resistant pathogens

are not seen in initial culture plates. Patient's immune status showed be taken in order the test. In HIV patientsand immune compromised individuals atypical microbes are common.

CT chest and chest X-ray should be repeated to find out the lesion clearance, worsening then and there. For pneumonia mimics and suspected malignancy invasive procedures such bronchial biopsies using FOB,USG guided FNAC or biopsy are warranted.

In conclusion, unusual infectious and noninfectious diseases should always suspected and included in the differential diagnosis of patients with presumptive diagnosis of pneumonia but who present with treatment failure, specially those young and previous healthy patients. The first step toward those diagnostics is to constantly be aware of their possible presence.

ULTRASOUND CHEST

Diagnostic ultrasonography is the only clinical imaging technology currently in use that does not depend on electromagneticradiation. This modality is based on the propertiesof sound waves, and hence the mechanical and acoustic properties of tissues. Air is a poor medium for sound transmission. As lung contains air, ultrasound of the lung may seem counterintuitive. The interface between chest wall and normal lung with different acoustic densities reflects most of the ultrasound(15) waves, preventing a direct examination of an otherwise healthy lung.

In pathological conditions such as tumor invasion, consolidation or atelectasis, the alveoli are replaced with more dense tissue allowing better sound conduction. When the pleural space is occupied with fluid or the consolidated lung reaches the chest wall, it opens an acoustic window permitting ultrasound examination of the lung.

Regarding diagnostic ultrasound equipment, ceramic crystals in the transducer deform and vibrate when electronically stimulated to produce the sound pulses. Echoes that return to the transducer distort these crystal elements and produce an electric pulse, which is processed into an image.

Ultrasound in the hands of the Pulmonologist:

Diagnostic ultrasonography is a very valuable tool for imaging the chest because it causes no clinically significant biological effects, is a real-time examination and has multi planar imaging capability. In real time one can focus the study on a painful or palpable area. This modality of ultrasonography can be portable, very significant for the ICU and emergency room. Trans thoracic ultrasound can be used to evaluate peripherally based lung lesion, pleural diseases.

The maximum visualization of the lung and pleural space is done by scanning along the intercostals spaces during quiet respiration for normal lung movement; and in suspended respiration when a lesion can be studied in detail.. Ultrasound is used as guidance for interventions such as biopsies or intercostals chest drains or pleural fluid taps .The high degree of spatial resolution in B-mode and the flow imaging in the Doppler mode help diagnose lesions in the thoracic wall The modality of ultrasound can be used to distinguish a chest wall mass from a breast mass and can be used to guide a biopsy needle into the tissue .

The skin of the thoracic wall appears on ultrasound images as an echogenic layer 1–3mm thick. Subcutaneous fat is just under the skin. The large muscles that comprise the middle layer of the chest wall are: the pectoralis, serratus, latissimus dorsi and trapezius. On ultrasound images skeletal muscle appears as uniform with multiple echogenic striae over a

hypoechoic background on longitudinal scans, and multiple echogenic dots over a hypoechoic background on transverse images. Ultrasound has been used to illustrate the extent of an anomaly such as the absence of muscle in Poland's syndrome. The deepest layer of the thoracic wall is comprised of ribs , the intercostal musculature, and the parietal and visceral layers of the pleura.

Principles of Thoracic Ultrasound

Lung patterns during examination are mostly dynamic and the thoracic ultrasound examination **is largely based on the analysis of artifacts** . Familiarity with various common artifacts and adequate technical skills are the basic requirements for thoracic ultrasound.

The examination using USG is dependent on the skills of the individual operator and the orientation of the probe. So, reproducibility of images is not as precise as with other imaging such as CT. An optimal image acquisition depends on the choice and placement of the appropriate probe with an adequate preset at the right spot at an optimal angle with the patient in the best possible position. Good thoracic ultrasound examination consists of not just the acquisition of static images but analysis of the dynamic sono morphological changes associated with probe positioning or respiratory movement(17)

Echogenicity

Ultrasound images are displayed on a gray scale. The strongest echo appears white while it is black when no sound wave is reflected from the organs. Depending on thereflected wave amplitude, the following terms are used to define chogenicity. When no sound wave is reflected and the image appears black it is *anechoic* as in pleural effusion.It is *isoechoic* when the echoes are of comparable amplitude with the surrounding tissue as with kidneys or spleen. It is *hyperechoic* when echoes are stronger than the surrounding tissue as in diaphragm, and *hypoechoic* when it is weaker than that from the surrounding tissue

Description of Probe

Penetration lung tissue decreases as frequency of the probe increases. Superficial organs are better visualized with higher frequency and deeper structures with lower frequency transducers. The gain and the power of the ultrasound need to be adjusted to obtain an adequate image. Most ultrasound equipments have preset modes for better imaging of specific organs of the body. For superficial imaging, a preset for the thyroid gland is useful. Otherwise most of the thoracic structures may be examined with abdominal preset. The size of the probe is vital in real-time interventional procedures. A smaller probe will leave more room for needle insertion during real-time vascular access, thoracentesis, tube thoracostomy or percutaneous biopsy. There areprimarily three types of transducers used in thoracic imaging, e.g. linear array, curvilinear array and a phased array.

Linear array transducers(fig 5a) have piezoelectric crystals arranged in a linear sequence on the transducer head . Parallel pulses are generated forming a line of sight perpendicular to the transducer face with a large footprint (part of transducer in contact with body surface). It produces a rectangular display. A linear array 7.5- to 10-MHztransducer with a thyroid preset is best to visualize superficial structures of the neck. This is also useful for vascular access or to determine pleural thickening, pleural masses or subpleural parenchymal lesions of lung. These high-frequency transducers provide an excellent high-resolution image of superficial structures but are not ideal for deeper tissue examination.

The curved array transducers (fig 5b) consist of linear arrays shaped into convex curves that produce a large field of view with a large footprint . These provide a pie-shaped image and are helpful to examine large pleural effusion,lung or abdominal structures or to view the lung from an abdominal approach. In the phased array transducers, crystals located on the transducer head are pulsed as a group and the direction of the beam is continually changed in phases producing a pie shaped image with a smaller footprint .The benefit is a relatively smaller transducer with a large field of view at depth. A 2- to 5-MHz-phased array or a sector probe is good to visualize deeper structures such as atelectatic lung, complicated pleural effusion or heart through the intercostals space. They are also useful to visualize the pleural space from an abdominal approach through the liver.

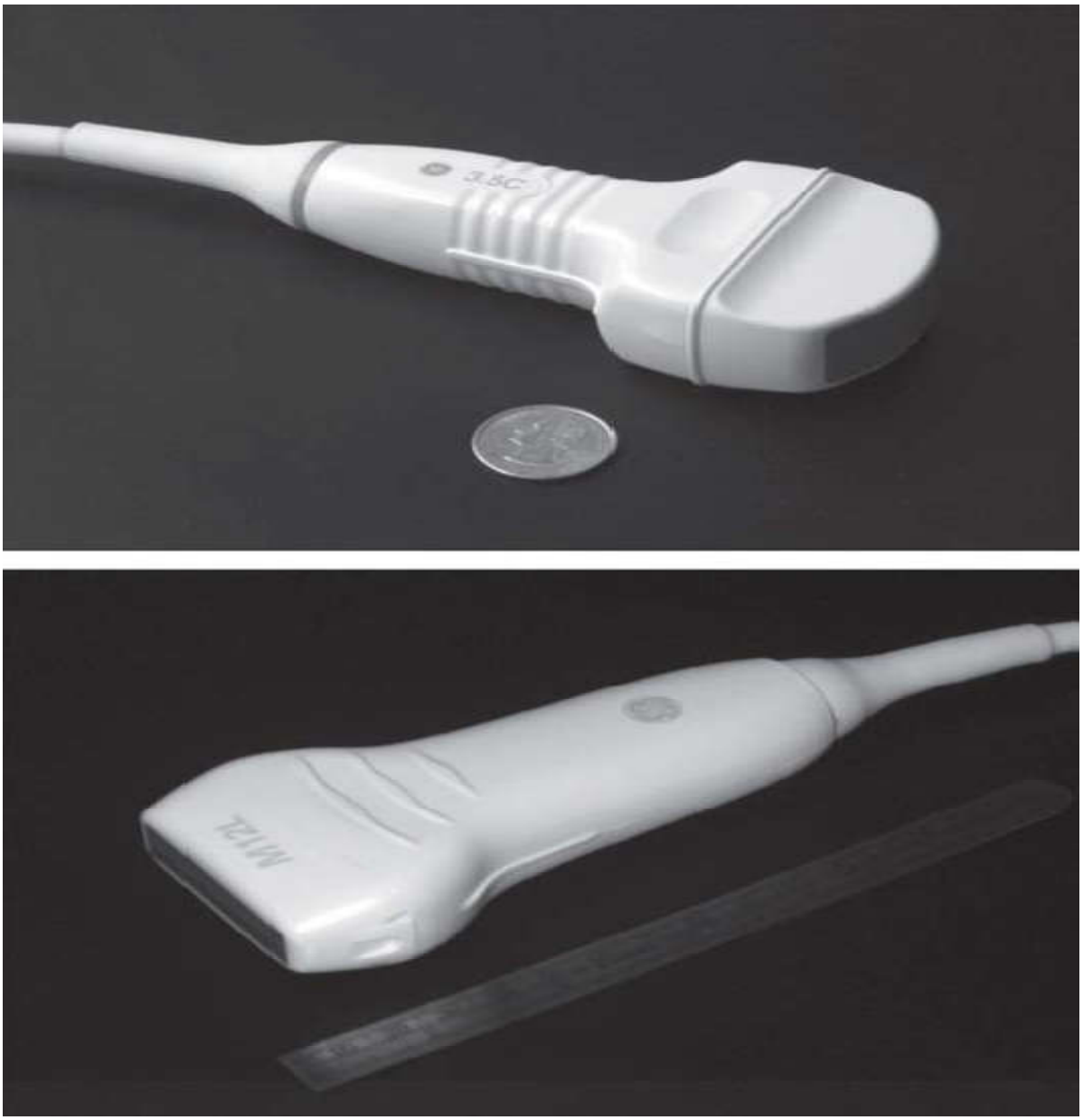


Figure 5 :curvilinear probe and linear probe

Position of the Patient and Relationship with Other Organs

In the ultrasound nomenclature, a popular term used is the earth-sky axis. The thoracic organs are composed of water and air. Air rises and the water descends following the rules of gravity. Intrathoracic organs and pleural fluid shift with different patient positions. Successful examination depends on appropriate understanding of the anatomy in relation to patient position during image acquisition

The lymph nodes or tumors of the anterior mediastinum that are not in contact with the chest wall in supine position may come against the chest wall when the patient is turned to a slightly prone left or right lateral decubitus position. A sitting position is ideal to localize very small pleural effusion, as most of the fluid is then collected in the costodiaphragmatic recess. The probe may need to be held close to the surface of the bed to locate pleural fluid in a supine patient in the ICU. Masses or lymph nodes in supraclavicular or the anterior mediastinum may be best visualized by turning the patient's head to the extreme right or left or in flexion or extension. Pleural space can be visualized better from a posterior approach in a sitting patient with the hand placed on the opposite shoulder or above the head.

Orientation of Transducers

The interpretation of trans thoracic USG images is based on the skill of the operator to correlate the obtained images virtually with the patient anatomy. Although ultrasound provides a 2-dimensional image, by sliding or tilting the transducer or by observing respiratory movement, a 3-dimensional dynamic image may be reconstructed in the mind. Being able to see the 3-dimensional image of the pathological changes is a key factor in image interpretation. Depending on the location of the target organ, patient position, clinical complaints, chest radiograph or CT images, the examiner tries to orient the transducer to the best possible site. However, this requires experience. Each transducer is marked with a probe indicator, signifying the direction of examination that corresponds to a marker on the display screen. Usually this marker is placed on the left upper corner of the display screen; however, most current ultrasound units allow customization of the screen.

The probe indicator of the transducer is placed in the cephalad direction during sagittal scanning of the chest. The probe indicator should be placed as much cephalad as possible when scanning through the inter costal window along the rib axis. Intrathoracic structures may be visualized better by holding the probe along the longitudinal or transverse axis over the rib spaces. It may take several attempts to find the best position and the correct angle to inspect a target structure. Anatomic landmarks are of assistance especially before any invasive procedure. Pleural surface on the right side is limited by the liver and the diaphragm, and on the left by the spleen with the diaphragm. The demonstration of kidneys

on either side indicates structures below the diaphragm. The sono morphological image of an empyema is very similar to a full stomach. Identification of these organs will assure a safe procedure and prevent needle puncture of liver, spleen or a full stomach.

Technical Skills

Good hand control is essential for successful scanning. By holding the probe comfortably, visualization can be maximized with a gentle rotating and rocking movement of the transducer. By sliding the transducer slowly over different rib spaces, a better window for visualization may be found. Using the thenar eminence to stabilize the hand against the chest wall during examination will prevent any unintentional sliding of the probe.

PROCEDURE:

It is **important to analyse the the patient's chest x-ray or CT to finalise the area of interest before doing USG**. Maximum visualization of the lung and pleural space is achieved by scanning along the intercostal spaces. USG must be done when is the patient lies quiet and respire normally(FIGURE 6). Sonographic views of the different areas depend upon where you place the probe.

Figure 6 : Patient position while doing usg.

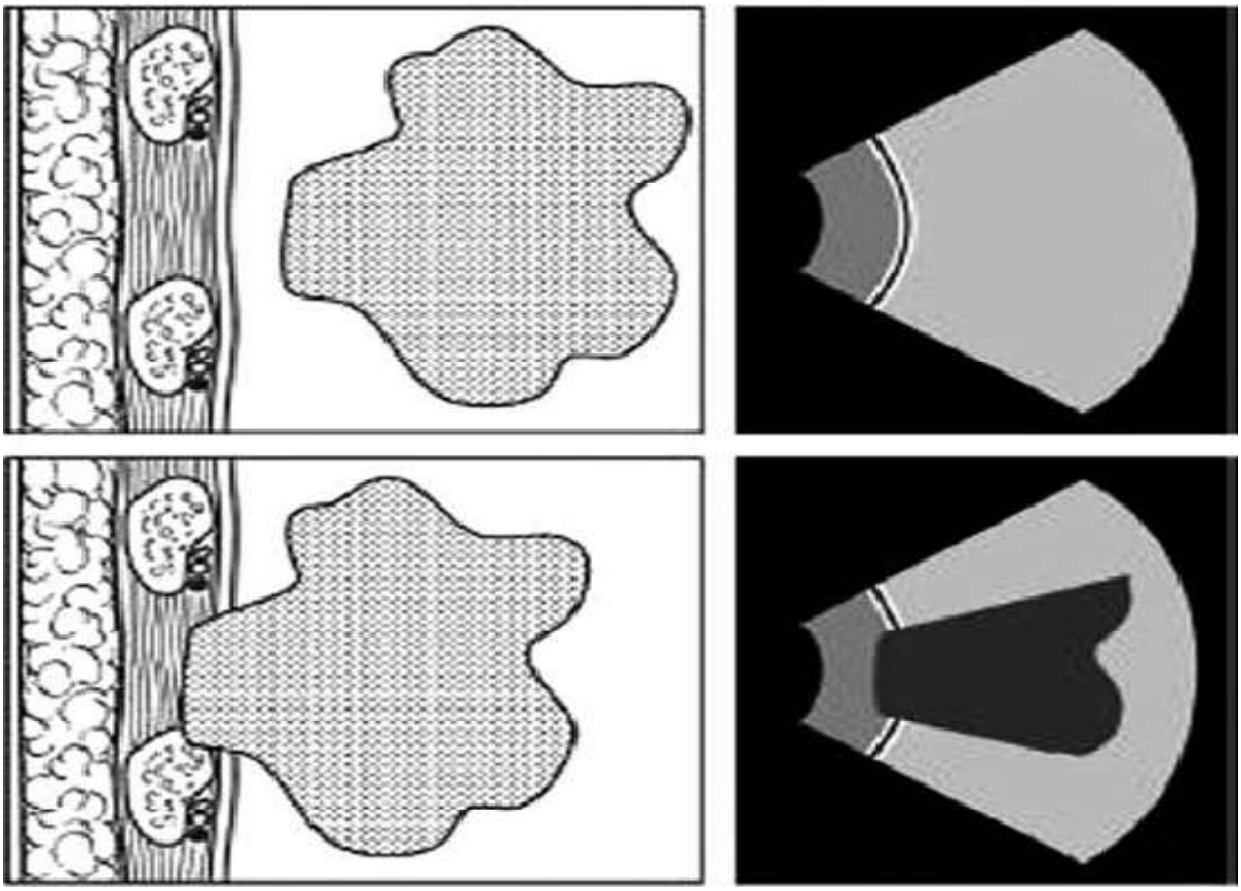


Figure 7 : A peripheral lung lesion is shown schematically without (top) and with (bottom) pleural contact. The corresponding sonar images recorded with a sector scanner are shown on the right. Only thelesion with pleural contact is visible on USG. Note that the acoustic window is too narrow to demonstrate the whole circumference of the lesion.

Peripherally based lung mass or consolidation can detectable by means of USG, although the extent of disease appears smaller at US than on chest radiographs.the lung consolidation appears diffusely echogenic, similar to the liver seen in abdominal ultrasound (Figure 7).

ULTRASOUND CHEST SHOWING AirBronchogram

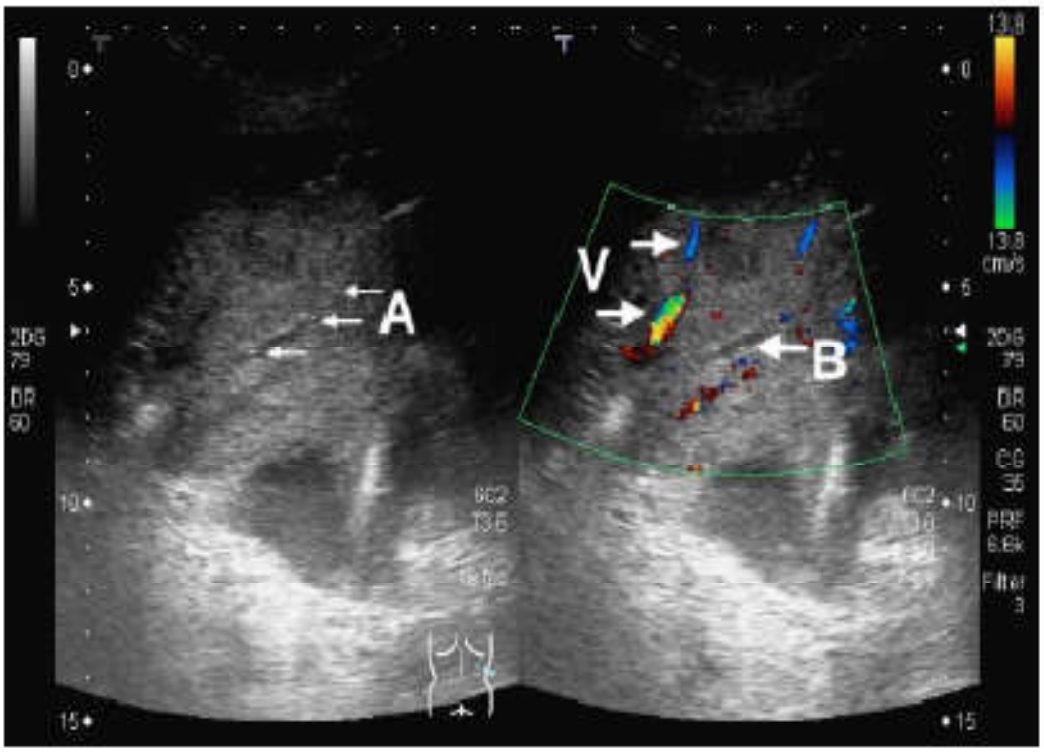


Figure 8:USG chest showing hyperechoic lesion with air bronchogram

USG CHEST SHOWING LUNG TUMOUR

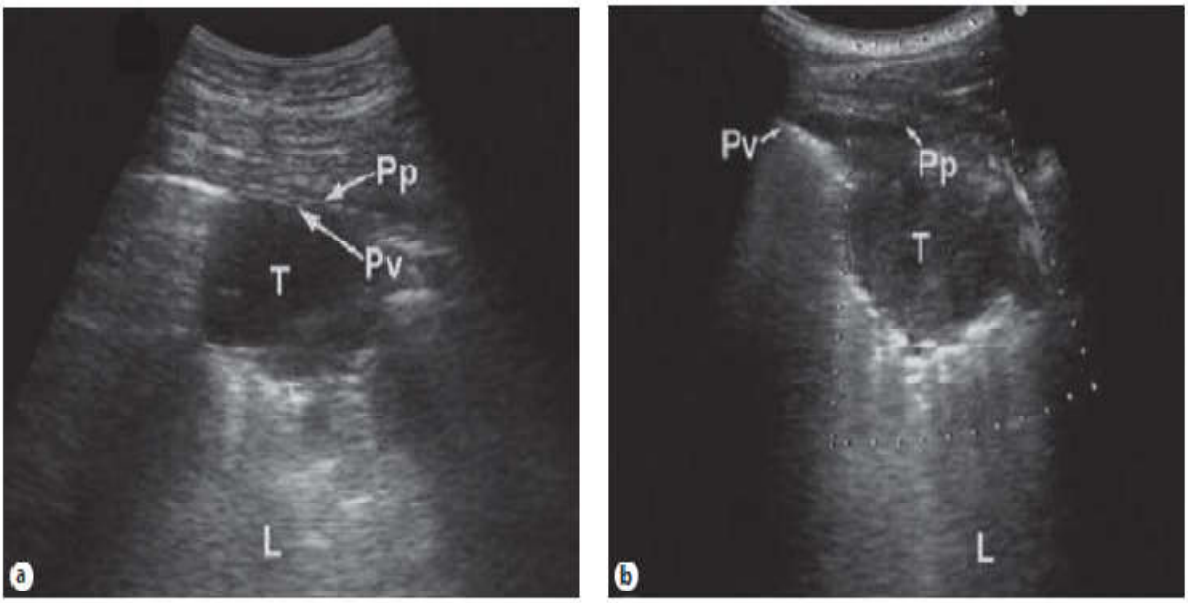


Fig. 8. a An US image showing a lung tumour with posterior echo enhancement. Note that both the visceral as well as the parietal pleural lines are intact. b This US shows tumour extension beyond the pleura. The visceral pleural line is interrupted, and the respiratory movement of the tumour is disturbed in real-time US. Invasion of the pleural cavity by the tumour is evident. L = Lung; T = tumour; Pv = visceral pleura; Pp = parietal pleura [from 2, with permission].

USG CHEST SHOWING CYST

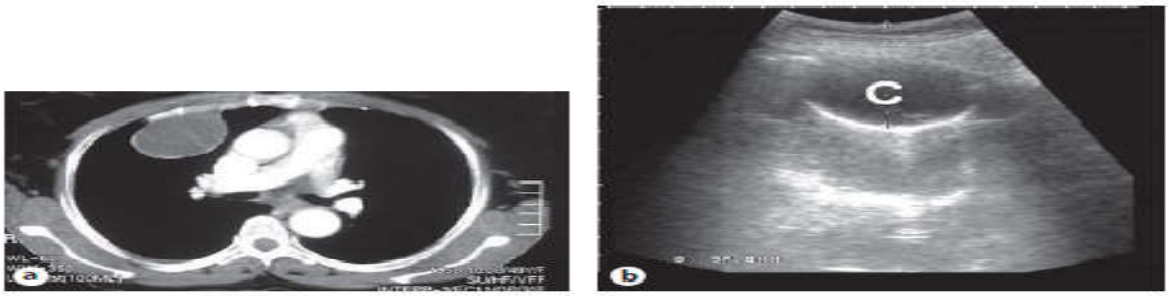


FIGURE 9: USG SHOWING HYPOECHOIC LESION DENOTING CYST

Figure 10 : USG CHEST shows consolidated lung appearing isoechoic to the liver. Air bronchogram is seen as multiple echogenic images inside the lung

Clinical Applications of Ultrasound

Ultrasound technology ranging from bulky machines to ultraportable pocket size equipments are now available. Thoracic USG is used to identify following pathology:

Pneumothorax

Air localized within the pleural cavity collects in the nondependent part and is best identified in the supine position with the probe held perpendicularly on the anterior chestwall. A pneumothorax is usually diagnosed by the absence of sea shore sign and presence of bar code sign. M-mode is of additional help. Operator experience is crucial to analyze these artifacts.

Pneumonia

Consolidated lung in contact with chest wall or contained in pleural effusion may appear as echogenic. Similar findingsmay be seen with pulmonary hemorrhage, bronchoalveolarcarcinoma or a lung infarct. Branching hyperechoic structures representing air bronchogram may be seen. Atelectatic lung is usually echogenic without any air bronchogram.

Primary or Metastatic Lung Cancer

Peripheral lung masses close to the pleura appear hypoechoic;however, it may become echogenic with bleeding. Diaphragmatic involvement can be detected through liver with an abdominal approach or with a transthoracic approach when pleural effusion is present

Chest Wall and lymph nodes

Soft tissue invasion of the chest wall by a primary lung cancer or chest wall tumor is easily detected. Ultrasound provides a better image of the Pancoast tumor than CT .Only MRI offers a good image of this complex anatomical location. Comparison of findings with the healthy normal side may be a clue to diagnosis. Bony invasion of tumors like plasmocytoma appear as hypoechoic lesions. The fracture of ribs or clavicle can be identified. Benign or malignant lymph nodes can be differentiated based on the consistency or vascularity.

Ultrasound-Guided FNAC

Subpleural peripheral lung, pleural-based or chest wall masses can be safely aspirated with ultrasound guidance.This technique largely depends on obtaining an image through an adequate acoustic window. A lung abscess reaching the chest wall may be percutaneously drained with ultrasound guidance.

To **conclude** USG is as effective as CT for guidance of transthoracic needle aspiration of peripherally based lung lesion and offers a number of advantages. In USG is useful diagnostic tool for critically ill patients with chest disease.

FINE NEEDLE ASPIRATION CYTOLOGY-LUNG

Non resolving or slowly resolving pulmonary pathology is often diagnosed using fine-needle aspiration cytology technique . Appreciation of FNAC for lung lesions has been rapid due to the difficulty in diagnosing peripherally based lung mass or consolidation. sensitivity of FNAC and simpler ways of treating the complications associated with the procedure has made FNAC an important diagnostic modalities

Infections such as tuberculosis and other benign lesions may be proven by FNAC but the main purpose still remains the diagnosis of suspected malignancy of lung parenchyma and pleura. All pulmonary lesions including hilar lesions are now routinely and safely diagnosed using FNAC under USG or CT Guided. FNAC of palpable lymph nodes can also be done.

FNAC IN DIAGNOSIS of LUNG INFECTIONS:

FNAC is very useful in diagnosing tuberculous lesion which is endemic in our country. FNAC of lung parenchyma infected with Mycobacteria typically shows on caseating granulomas (figure 11)which will guide in further treatment.

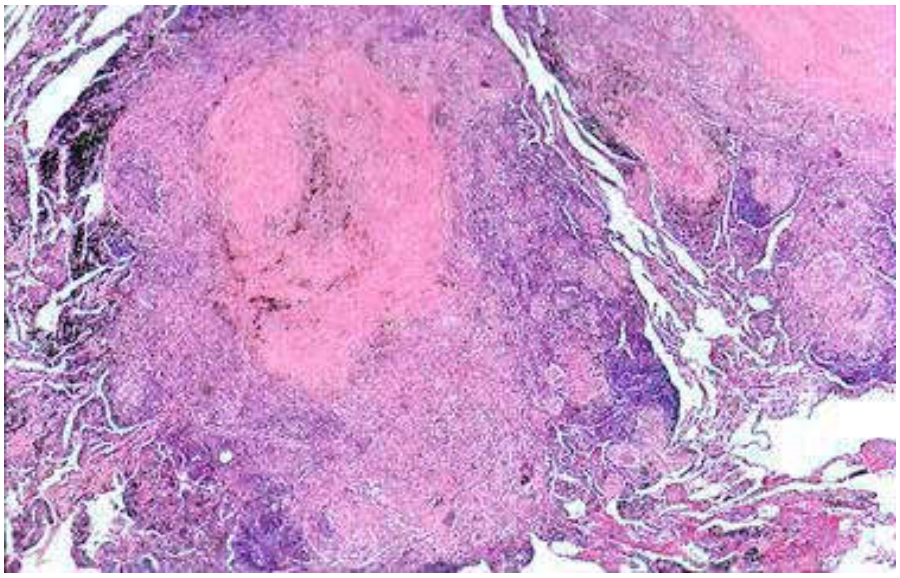
- 

Figure 11: confluent granulomas are surrounded by dark blue lymphoid cells. At the center of the confluent granulomas is a pink zone of necrosis

A suspicious tuberculous infection with (pyrexia, night sweats, contact with tb patient) coupled with positive aspirate, sputum AFB adds to the diagnosis of TB.

- Actinomycosis infection usually seen in immunocompetent patients with respiratory disorders, poor oral hygiene, chronic alcoholic .It iscaused by actinomyces species, especially *Actinomyces israelii*. Typical CT findings are reported as central areas of low attenuation within the consolidation. FNAC (Figure 12) helps in diagnosing the lesion. FNAC has been proven to be a simple, safe, and effective diagnostic technique that reduces the number of unnecessary resections(36).

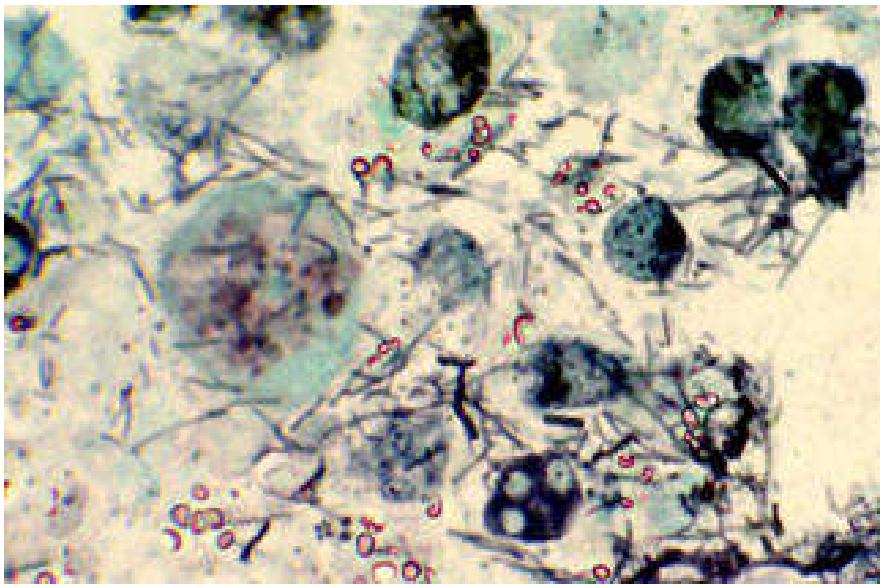


Figure 12: 'Sulphur granules' are crushed between slides and stained by gram stain and examined. The granules are, in fact, bacterial colonies and will be found to consist of a dense network of thin Gram positive filaments, surrounded by a peripheral zone of swollen radiating club shaped structures, presenting a sun ray appearance

- In non resolving lung abscess caused mostly by aerobic and anaerobic bacteria,FNAC has a role in diagnosis and therapy. Common bacilli that includes S pneumonia mainly leads to acute inflammation characterized by sheets of polymorphonuclear neutrophils ,histiocytes, nuclear debris and necrosis (figure 14)which results in tissue destruction causing lung abscesses

Figure 13: macroscopically pus is aspirated.

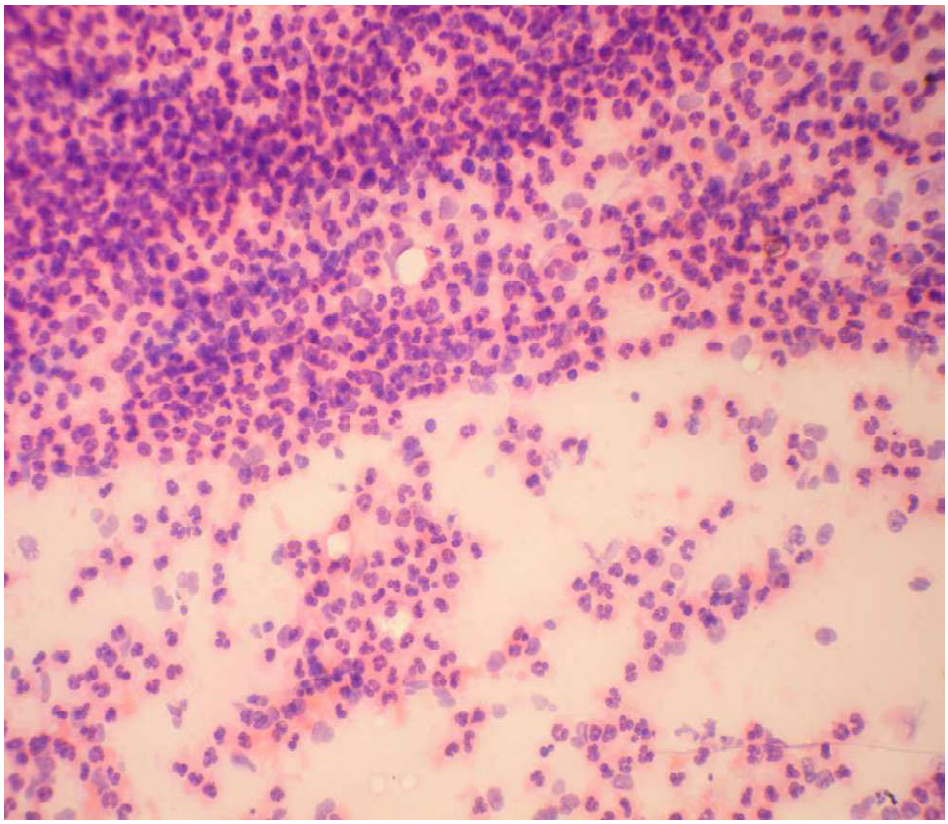


Figure 14: Sheets of acute inflammatory cells in suppurative inflammation

- Incidence of fungal infections risen over the last two decades because of of emergence of HIV infection and solid organ transplant . *Aspergillus, Cryptococcus* and *Candida* are the most common fungal infections. On microscopic examination, the hyphae of the *Aspergillus* species are septate with regular, progressive and dichotomous branching usually at acute angles (45º angle) from the parent hyphae(figure 15).

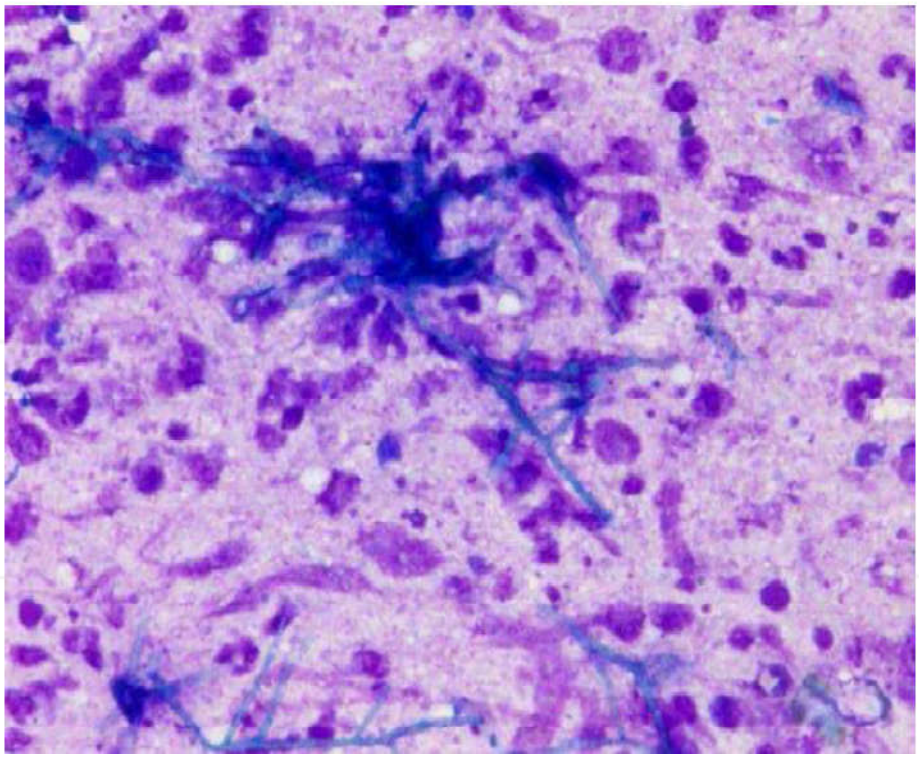


Figure 15: A long septate hyphae with parallel cell walls of aspergillus in a necrotic background

FNAC IN BENIGN LESIONS:

- Sarcoidosis is a disease of unknown aetiology that can be characterised by the histological hallmark of non-caseating granulomas. Most patients present with the classic combination of bilateral hilar lymphadenopathy, parenchymal disease of the lung, and eye or skin lesions

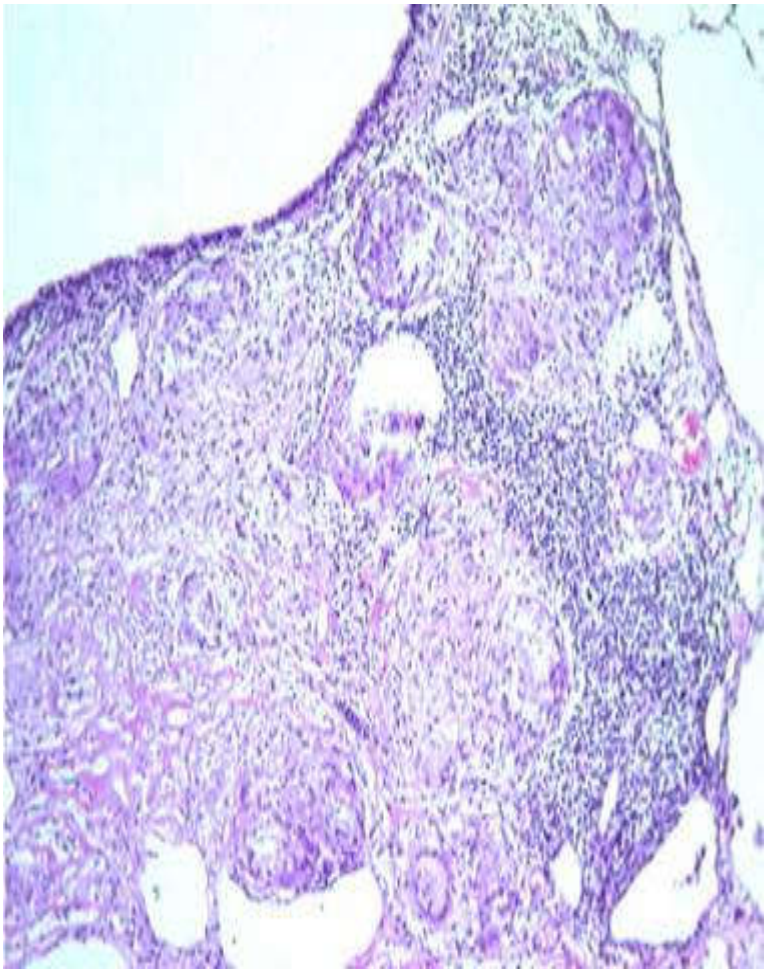


Figure 16: shows characteristic noncaseating granulomas with many giant cells.

- Thymoma(figure 17) is the most common anterior mediastinal tumor. FNAC has a major role in diagnosis of thymoma and other anterior mediastinal tumors because management varies.

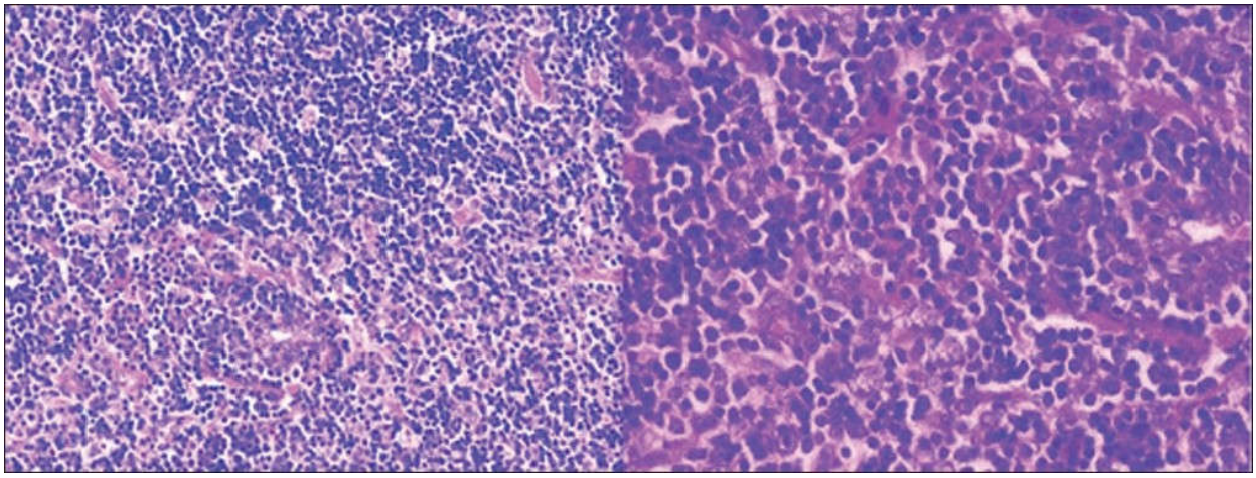


Figure 17 : Biphasic pattern of cohesive epithelial cells in a background of lymphoid cells

- Schwannoma(figure 18) is the most common thoracic paravertebral mass lesion in the adult. Schwannomas appear as well-circumscribed, round masses that are of homogenous soft-tissue density on plain CT images.

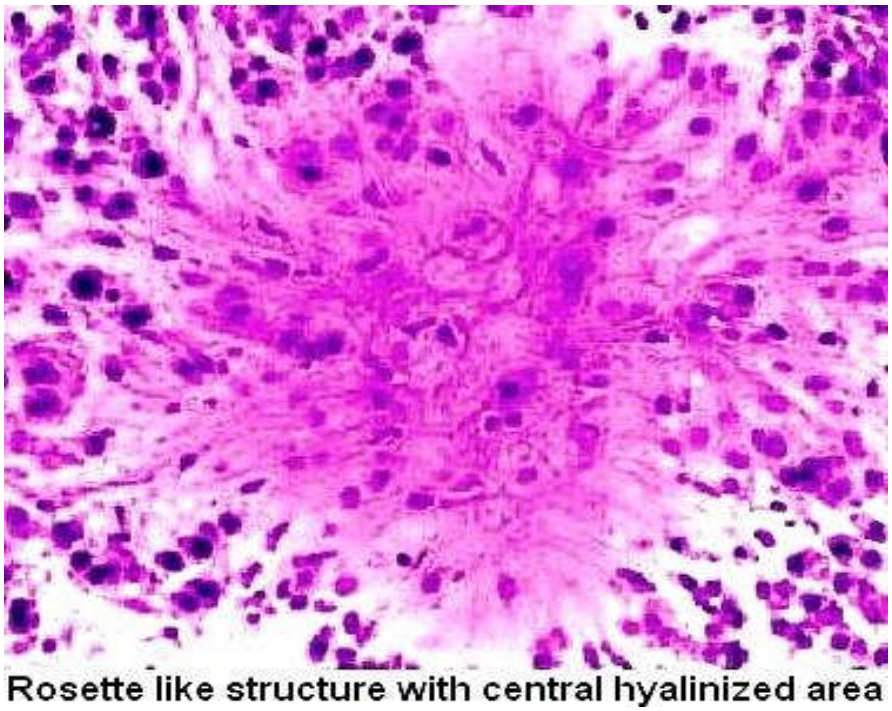


Figure 18 : Rosette like structure with central hyalinized area

FNAC IN PREMALIGNANT AND MALIGNANT LESIONS:

FNAC is highly cost effective ,first line investigative technique in diagnosing premalignant and malignant lung lesions nowadays .a good sample and a well informed pathologist is the key for diagnosis

- In premalignant and carcinoma in situ case such as squamous dysplasia(figure 19) ,FNAC assist in period review of progression of lesion.Repeated FNAC aid in diagnosis.

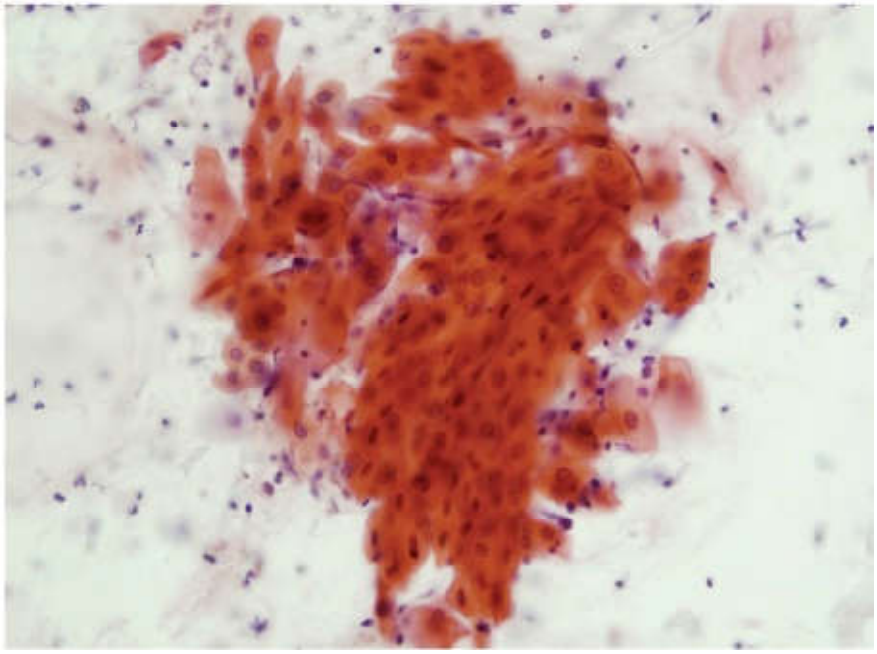


Figure 19: cytology of squamous dysplasia resembles squamous metaplasia with nuclear atypia (Papanicolaou stain).

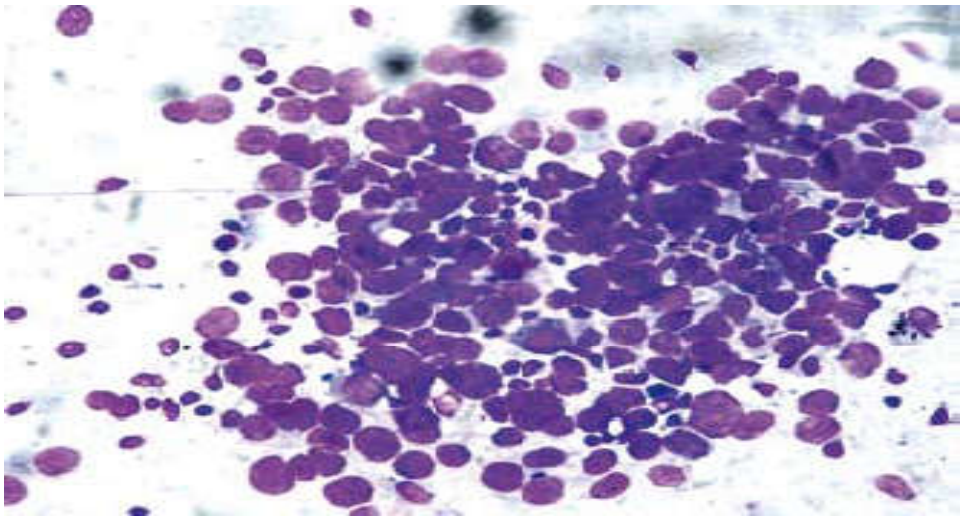


Figure 18: Undifferentiated carcinoma – Highly pleomorphic,undifferentiated cells in sheets

- Majority of lung malignancy is diagnosed in advanced stages, where cytology or small biopsy material is the only form of tissue diagnosis, thus placing cytology, especially fine needle aspiration biopsy in the front line for management of lung cancer patients. Published reports reveal that the sensitivity of FNAC in diagnosis of lung malignancy ranges from 55- 90% whereas specificity is close to 100%. In nearly all these studies, the overall positive predictive value is nearly 99%.

Lung cancer histological subtypes that are morphologically recognizable on cytology specimens are adenocarcinoma, squamous cell carcinoma,small cell cell carcinoma and large cell carcinoma.

SMALL CELL CARCINOMA:

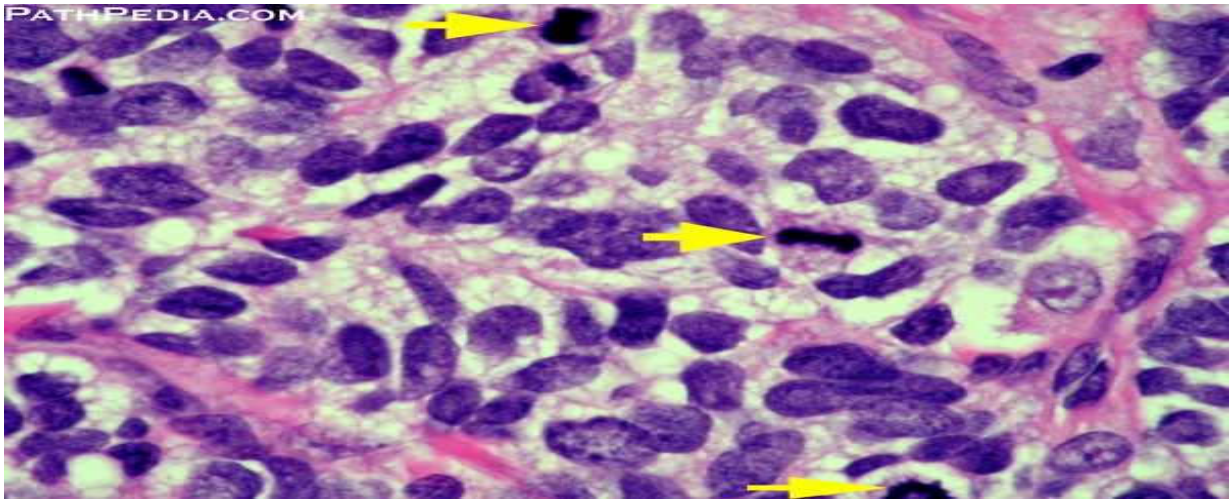


Figure 20: diffuse proliferation of small to intermediate sized cells (arrow) generally ith very scant cytoplasm and round to oval hyperchromatic nuclei. The tumor cells are generally larger than small lymphocytes

SQUAMOUS CELL CARCINOMA:

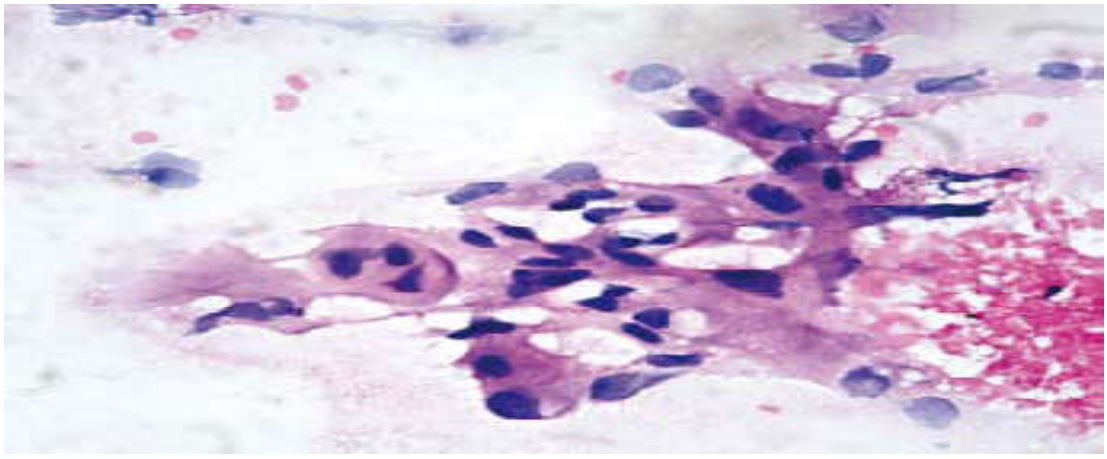


Figure 21: neoplastic cells with abundant pale eosinophilic cytoplasm and a surrounding infiltrate of inflammatory cells which can also be seen among the tumor cells in the fine needle aspirate specimen

LARGE CELL CARCINOMA :

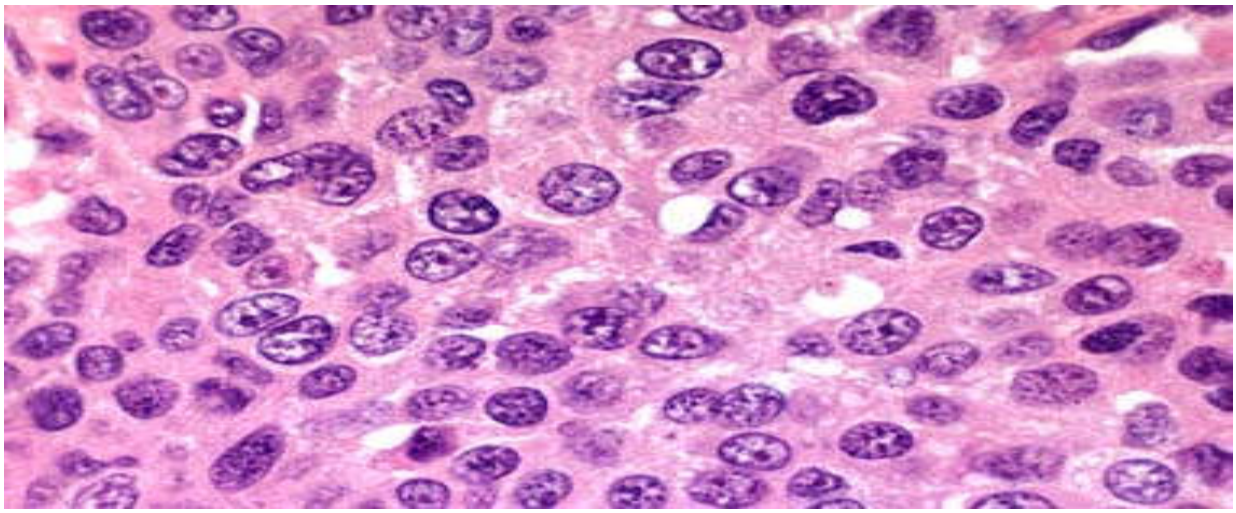


figure 22: cell size—larger nuclear:cytoplasmic ratio—lower nuclear chromatin—coarser nucleoli--present in many cells. certain large cell carcinomas have a nesting or trabecular pattern, often with rosettes

ADENOCARCINOMA:

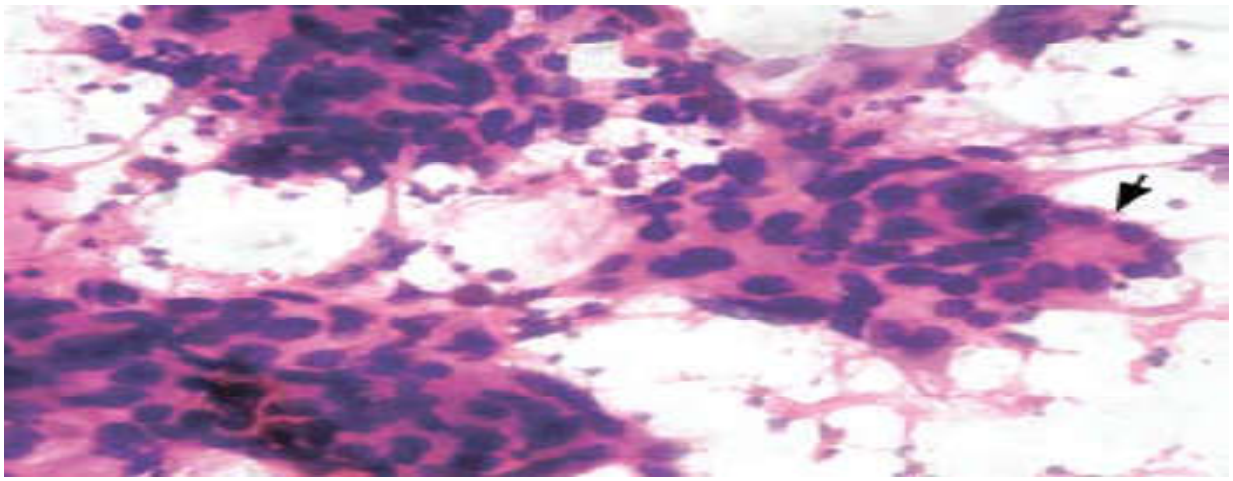


FIgure 23: Adenocarcinoma aspirates include architectural features in the cell sheets, such as gland acini or an anatomical border.

MESOTHELIOMA:

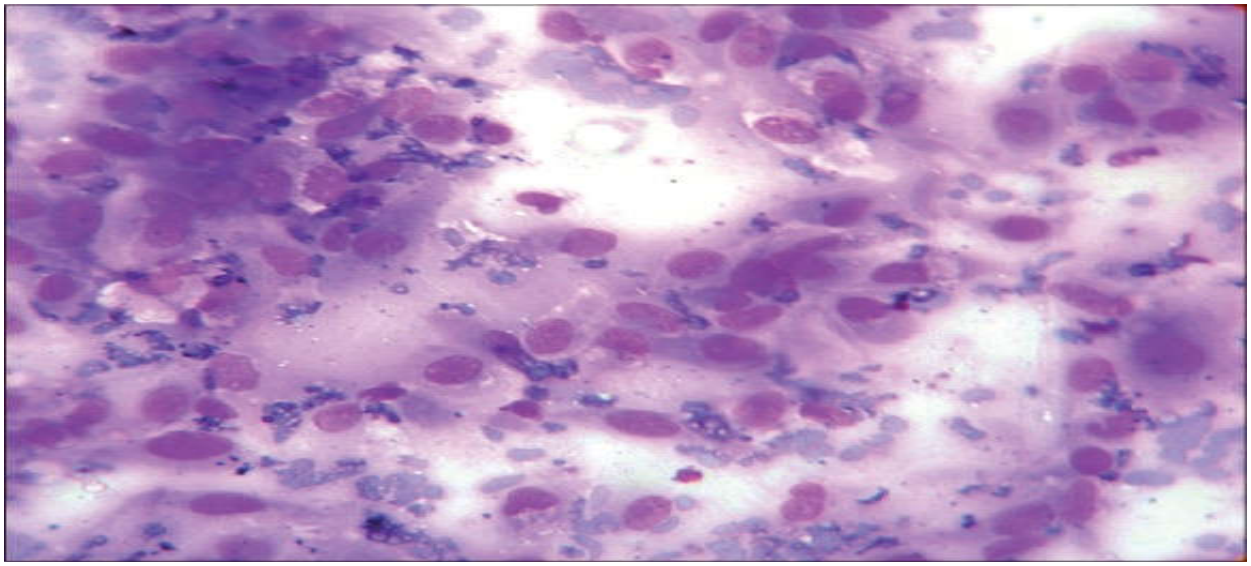


Figure 4: Smears consisted of dispersed populations of polygonal cells with cellular and nuclear pleomorphism along with spindle-shaped cells. Increased mitotic activity and features of necrosis were evident in the smears(17)

REVIEW OF LITERATURE

Many clinical studies and investigations had been conducted to study the usefulness of USG in the diagnosis of pneumonia. Most important study which brought USG guided FNAC in identifying lung pathology was done by group of histopathologist and interventional radiologists in Rajshahi medical college in Bangladesh.USG guided FNAC was done for 127 Patients whose lesion were very well visualized by ultrasound. The study was conducted for 2 years. This study was published in December 2007 in journal of teachers association,Rajshahi. Main objective of the study was to study diagnostic accuracy and cost effectiveness of ultrasound guided FNAC in diagnosing intra thoracic masses.

Nahar begum et al(24) subjected 127 cases (which was the large sample study) of thoracic masses to USG OR CT GUIDED FNAC. Smaller lesions,deeply blocated ones,mediastinal or juxta hilar lesions which were not visualised sonographically ,FNAC was done using CT GUIDANCE. In 106 cases of USG –GUIDED FNAC, conclusive cytodiagnosis was made in 98 cases resulting in diagnostic accuracy of 93.8%.No diagnosis was obtained in 6 cases. Complication such as pneumothorax or hemoptysis were noted in larger lesions and deeply seated lesions. Mild to moderate pneumothorax

developed in 7 (6.6%) cases and subsided with conservative treatment. One died within few hours of FNAC.4(3.8%) patients complained of hemoptysis post procedure which settled spontaneously.3 patients(2.8%) had hemorrhage which was managed conservatively. FINAL OUTCOME OF THE STUDY was USG GUIDED FNAC HAS SENSITIVITY 91.2% AND

SPECIFICITY 100%. FOR DIGNOSIS OF MALIGNANT LESION AND FOR BENIGN LESION DIAGNOSIS SENSITIVITY WAS 68% AND SPECIFICITY 100% .Prevalence of malignancy was 72.3%(n=76) and tuberculosis 11(n=11).The study finally concluded that ULTRASOUND guided FNAC is a very valuable diagnostic modality for early diagnosis which will enable expeditious treatment. More so in poor economic status of the patient who are unable to provide money for CT CHEST ,USG GUIDED FNAC HAS BEEN SHOWN TO BE A COST EFFECTIVE METHOD OF DIAGNOSIS.

The study which was conducted by interventional radiologist compared their data with studies done previously since 1988.These studies showed varied sensitivity ranging from 81 to 98 % and complication rate including pneumothorax,haemorrhage and hemoptysis ranginging from 42.7% to 1.1 %.All the studies were undertaken by radiologist who had hands on training in handling ULTRA SOUND.

From series of study published,MOHAMMED(33) et al series had an excellent diagnostic accuracy of 97%(out of 184 cases selected) and pneumothorax incidence was 1.1%.But incidence of hemoptysis was (5.4%).Following this series GOULIAMOUS(28) et al had a sensitivity of 98.4%,and pneumothorax incidence 3.1%.STANLEY et al who had largest series of patients who underwent USG guided FNAC had sensitivity of 96.6% but the incidence of pneumothorax was huge 29%.

All these studies were done exclusively done by WELL TRAINED QUALIFIED RADIOLOGIST who handle ULTRASOUND day and night.**Treating physician or the Pulmonologist were not involved in the diagnosis**

SUMMARY OF RESULTS OF REPORTED SERIES

References	of Cases	Diagnostic accuracy	Pneumothorax	Complication Bleeding	Hemoptysis
Stanley et al. 1988 [12]	458	96.6%	133(29%)	-	5 (1.1%)
Vansonnenbergetal 1988[4]	150	82.7%	64 (42.7%)	-	25 (3.3%)
Haramati et al 1995 [13]	32	81%	3 (9.4%)	-	-
Santambrogioetal 1997 [14]	110	81%	3 (9.4%)	-	-
Gouliamos et al 2000 [15]	64	98.4%	2 (3.1%)	1(1.6%)	-
Mohammad et al 2001 [16]	184	97%	2 (1.1%)	-	10 (5.4%)
Gupta et al 2002 [17]	37	91%	1 (2.7%)	1 (2.7%)	-
J P Sing et al 2004 [18]	34	85.3%	4 (11.8%)	4 (11.8%)	1 (2.9%)

Another study which was published in THORAX 2002 by PAN CHYR YANG et al ,national Taiwan university hospital .According to this study diagnostic accuracy of USG GUIDED FNAC WAS ONLY 30% whereas USG guided BIOPSY was 57%.Combination of both the test yielded a diagnostic accuracy of 63%.Commonest cause identified for non resolving pneumonia in that series were fungal pneumonia, tuberculosis and bronchoalveolar carcinoma. Two patients had complication, -pneumothorax and hemoptysis.

Qian-Jing Hu et al of West China Hospital of Sichuan university analysed studies published in pubmed,Ebase and Cochrane analysis. Results obtained from 9 different studies involving 1080 patients on chest USG as diagnostic tool were pooled using a **bivariate meta**

analysis. SUMMARY ESTIMATES IN THOSE STUDIES SHOWED SENSITIVITY -0.97 AND SPECIFICITY 0.94.POSITIVE LIKELIHOOD RATIO 15.62(95%) NEGATIVE LIKELIHOOD RATIO 0.03(95%). Accuracy is measured by the area under the ROC curve which was O.99.THIS META ANALYSIS showed lung ultrasound is capable of diagnosing pneumonia with high accuracy and is a safe alternative test to CT chest and bronchoscopy. But demerit of this analysis was that this study didn't come up with percentage of pneumothorax and other complication. **Data lacking in this analysis was rate of complication such as pneumothorax, bleeding and haemorrhage which occurs during the diagnostic procedure.**

Another study conducted by **HAYDER et al** in college of medicine ,university of Babylon ,Iraq assessed the value and safety of USG guided lung FNAC in diagnosis of bonchogenic carcinoma. **Out of 75 cases evaluated by USG guided FNAC, 57 cases were diagnosed to have bronchogenic carcinoma**. There was no controversy between final diagnosis and FNAC results except in one case where gold standard biopsy showed TB infection and FNAC showed small cell carcinoma (false positive) in remaining 18 cases,

6 cases were benign lesions which later investigation showed malignancy(false negative results) 4 cases were slowly resolving pneumonia and 3 cases were tuberculous etiology

and 5 cases left out

Shivani kalhan et al(21)in army college of medical science,sarawathi instititute of medical sciences Uttarpradesh done an comparative study of USG guided FNAC and CT

guided FNAC in lung mass. Study was conducted on 120 patients. Only those cases in which sonographic guidance was not possible were taken up for CT guided FNAC. CT had a sensitivity of 93.2% and specificity of 100%. For USG guidance, the same was 91.3% and 100% respectively finally concluding that precision of both ct and USG guidance is comparable. The demerits of this study was that complications were not studied. More over USG and CT guided FNAC were done by pathologist under the guidance of radiologist.

Another study conducted in Tirvandrum medical college pulmonary Medicine department by **Jeyaprakash et al(10)** concluded that out of 70 patients included in the study. Tuberculosis was the commonest etiology of non resolving pneumonia (35.7%), followed by malignancy (27.1%), Bronchiectasis (8.6%), and Resistance to antibiotics(14.3%).In this study all investigation modalities were employed including USG chest.

The study published by MANS MADAN et al, department of pathology, Giansagar medical college AMRISTAR in Turkish journal of pathology stressed the accuracy of FINE NEEDLE ASPIRATION CYTOLOGY in diagnosis of thoracioc lesions. This study was done for one year.40 patients were included in the study out of which 24 cases (60%) had malignancy .In this study imaging modality was CT

Bhupendra kumar jain et al conducted a study which was published in Asian journal of medical sciences comparing the efficacy of FOB and CT guided FNAC IN DIAGNOSING NON RESOLVING PNEUMONIA. Out of 65 cases 53 patient were diagnosed with the help of FOB

WITH SENSITIVITY 81%.OUT OT 12 PATIENT WHO UNDERWENT CT GUIDED FNAC ,11 WERE DIAGNOSED THE CAUSE WITH SENSITIVITY 91%.63 cases (96.9%) were diagnosed by using both FOB and CT guided FNAC.in this study commonest cause for non resolving pneumonia was pyogenic infection(37%) followed tuberculosis 29.2% and carcinoma(23%).out of 12 patients who underwent ct guided FNAC 1 patient had pneumothorax and 1 patient had hemoptysis.

Simon Finch et al from Tayside Respiratory Research Group, University of Dundee, Scotland published an article about etiologies of non resolving pneumonia. According to his study most common causes are atypical pathogens such mycobacteria. According to them non-infectious causes are common than infectious disorders but may still affect >20% of patients with non resolving pneumonia.

With all these studies and results, I undertook my present study to test the diagnostic accuracy of ULTRASOUND GUIDED FNAC in the hands of treating PULMONOLOGISTS in diagnosing non resolving pneumonia and finding out the yield and causes of non resolving pneumonia.

MATIERIALS AND METHODS

STUDY TITLE:

YIELD OF ULTRASOUND GUIDED FNAC IN NON RESOLVING LUNG CONSOLIDATION IN TEACHING MEDICAL COLLEGE HOSPITAL ,TIRUNELVELI

Aim:

This study aimed to find out the yield of **ULTRASOUND GUIDED FNAC IN NON RESOLVING CONSOLIDATION. Sub study includes comparing the yield of USG guided FNAC and Bonchoscopy** in finding out the diagnosis of non resolving pneumonia

Settings and Design:

This is **Prospective observational study** conducted in a the department of chest medicine ,Tirunelveli government medical college hospital over a period spanning from may 2014 to august 2015(about 1 year and 8 months).

Materials and Methods:

After getting a due consent from medical institution's ethics committee study was started with the guidance from department of pathology and radiology. Inclusion and exclusion criteria were pre fixed and patients were selected accordingly. All patients received an empirical course of antibiotics as suggested by American Thoracic Society guidelines.

INCLUSION CRITERIA

1. **PATIENTS WHO FULFILL THE DIAGNOSIS OF NON-RESOLVING PNEUMONIA (NO RADIOLOGICAL RESOLUTION AFTER 4 WEEKS OF ANTIBIOTICS)**
2. **SPUTUM CULTURE NEGATIVE AND SPUTUM FOR AFB NEGATIVE**
3. **HIGH CLINICAL AND RADIOLOGICAL SUSPICION OF LUNG CARCINOMA**

EXCLUSION CRITERIA

1. **KNOWN PATIENTS OF LUNG CANCER**
2. **SPUTUM-POSITIVE PULMONARY TUBERCULOSIS**
3. **PATIENTS HAVING VERY POOR GENERAL CONDITION, VERY SEVERE BREATHLESSNESS, RECENT HISTORY OF MYOCARDIAL INFARCTION.**
4. **POSITIVE TEST RESULT FOR HUMAN IMMUNODEFICIENCY VIRUS(HIV) INFECTION**
5. **UNWILLING PATIENTS WERE OMITTED FROM OUR STUDY.**

STUDY PROTOCOL:

Clinical, radiological and laboratory tests were performed before initiating empirical antibiotics, and after they fail to improve after antibiotic therapy. A STRUCTURED PROFORMA was used. Patients age, sex and smoking history if present were noted. Prior investigations, sputum for AFB, sputum culture report and HIV reports were noted down .proper consent was obtained from the patients after procedure was explained in their local language and consent form duly signed in their local language. All patients who were included in the study were hospitalized for a day to look for complication such pneumothorax and bleeding. Chest x-ray were done 6 hours after the procedure. Standard operating procedure for managing PNEUMOTHORAX was fixed according to British Thoracic society guidelines. Investigations done in this study after labeling the patient as patient with non resolving pneumonia were ultrasound guided FNAC done with 21gauge needle and bronchoscopic wash culture and cytology and biopsy if warranted.

INSTRUMENTATION:

ULTRASOUND LT200 MODEL WITH CURVILINEAR PROBE WITH FREQUENCY OF 3.5 MHZ TO 5MHZ WAS USED BY THE **PULMONOGIST** and chest medicine postgraduates who were trained in handling ultrasound.10 ml syringe with 21 gauge needle was used for FNA and smear slides were air dried and sent to pathology department. Bronchoscopy was done using Olympus fibre optic bronchoscope and specimen were collected under standard norms and sent for culture and histopathology.

RESULTS

SAMPLE SIZE:

Sixty two (N = 62) patients who filled the study criteria BOTH inclusion and exclusion criteria were selected for the study.

GENDER :

Out of 62 patients ,majority were males 89%(n=55) and females were only 11%(n=7)(figure 25)

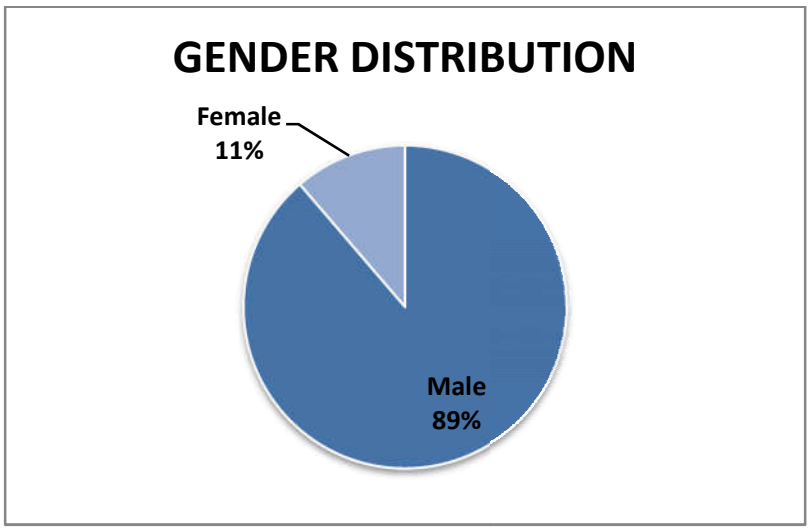


Figure 25:Gender distribution

AGE DISTRIBUTION:

3%(n=2) patients were between(21-30years),5%(n=3) were between (31-years),16%(n=10) were between 41-50 years ,32% (n=20) were between 51-60 years,34%(n=21) were between 61-70years which was majority age group and 10%(n=6) were between 71-80years age group(figure 26)

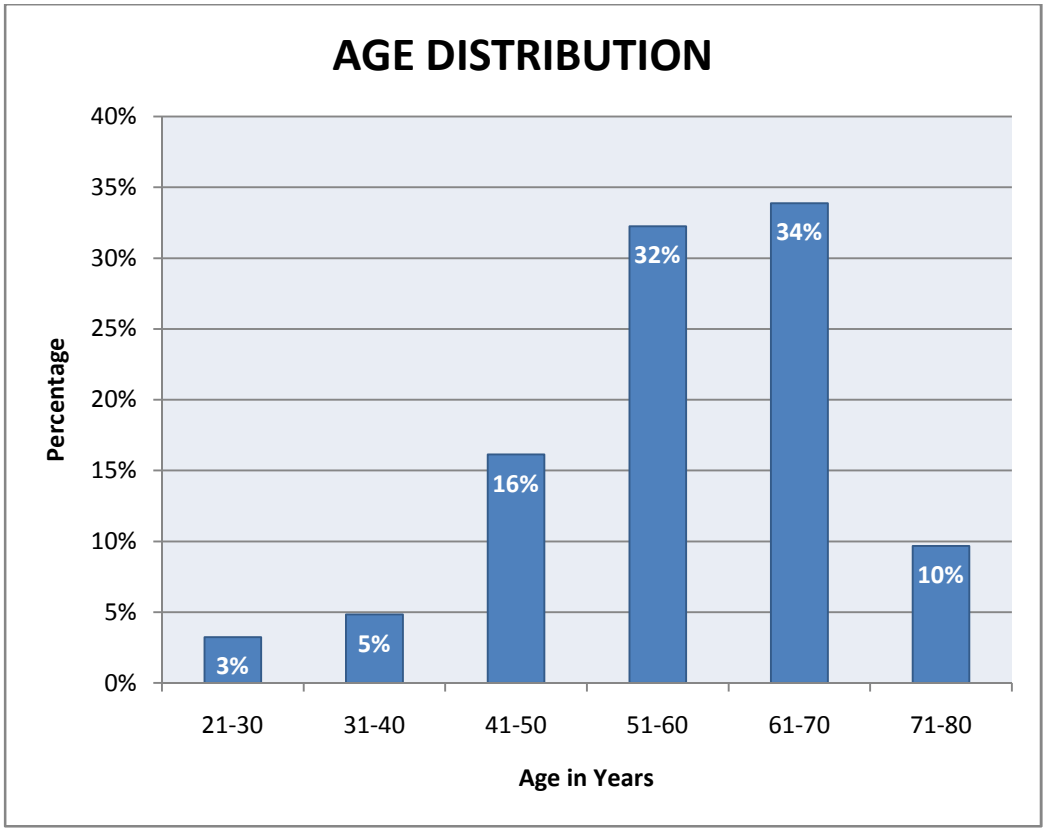


Figure 26:Age distribution

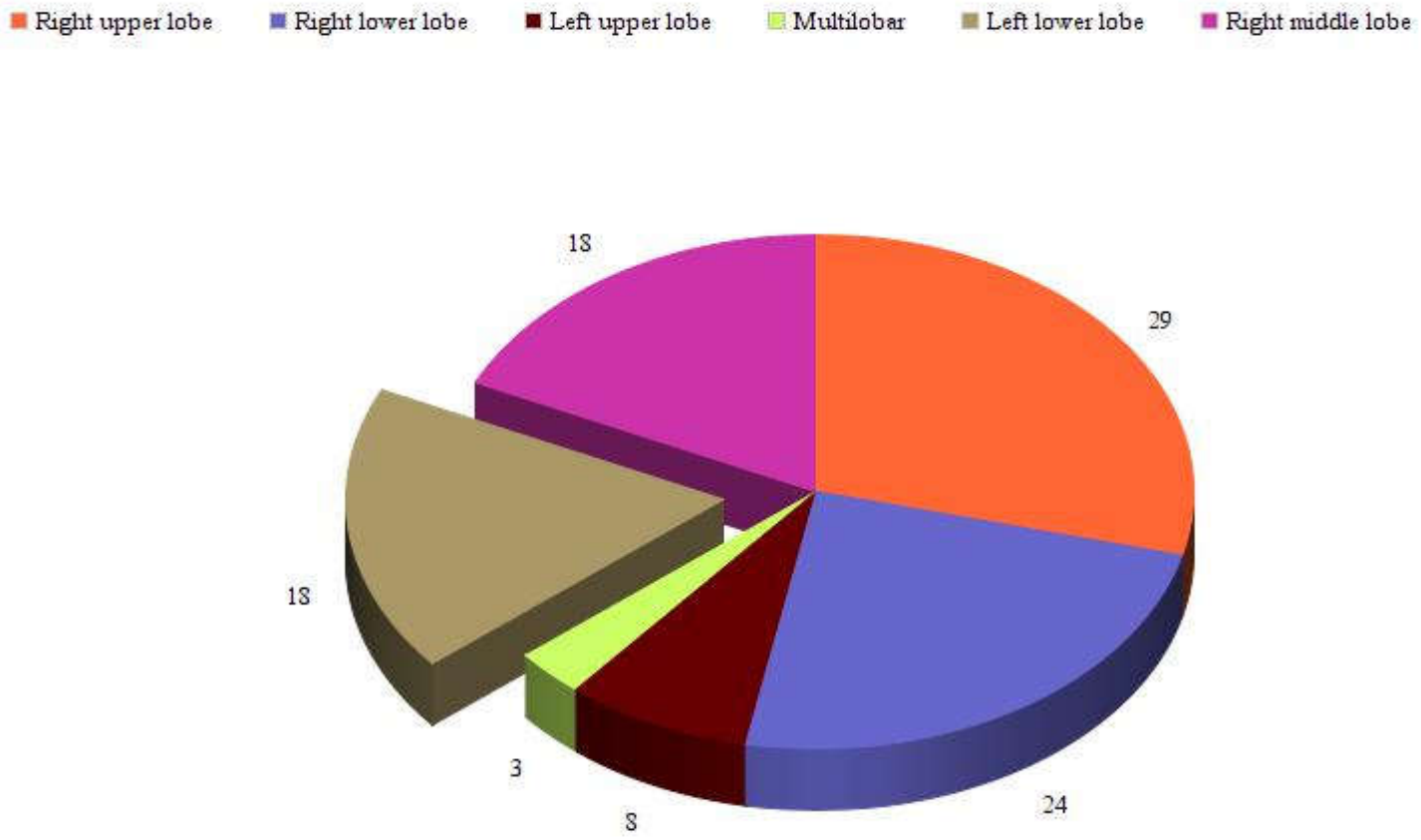
CT PATTERN IN THE STUDY

Computerised tomography of patients with non resolving pneumonia included varied distribution. Consolidations that were adjacent to chest wall were the ones selected for ultrasound guided FNAC. Majority of the patients with non resolving pneumonia had lesions(table 2) in right upper lobe29% (n=18) followed by lesion distributed in right lower lobe 24%(n=15).Non resolving consolidation was seen in equal proportion in right middle lobe and left lower lobe 18%(n=11). Consolidation were seen in 8%(n=5) of left upper lobe. Multi lobar distribution of consolidation were seen in 3%(n=2).

Table 2: CT PATTERN

CT PATTERN	N – 62	%
Right upper lobe	18	29%
Right lower lobe	15	24%
Left upper lobe	5	8%
Multilobar	2	3%
Left lower lobe	11	18%
Right middle lobe	11	18%

CT PATTERN IN THE STUDY



YIELD OBTAINED BY FNAC

In 59 patients out of 62 with undiagnosed non resolving consolidation .USG guided FNAC established the etiology. Percentage of yield was staggering 95.2%. In 3 cases results were inconclusive. Percentage of NO YIELD was 4.8%.(Table 3)

Table 3: YIELD OF USG GUIDED FNAC

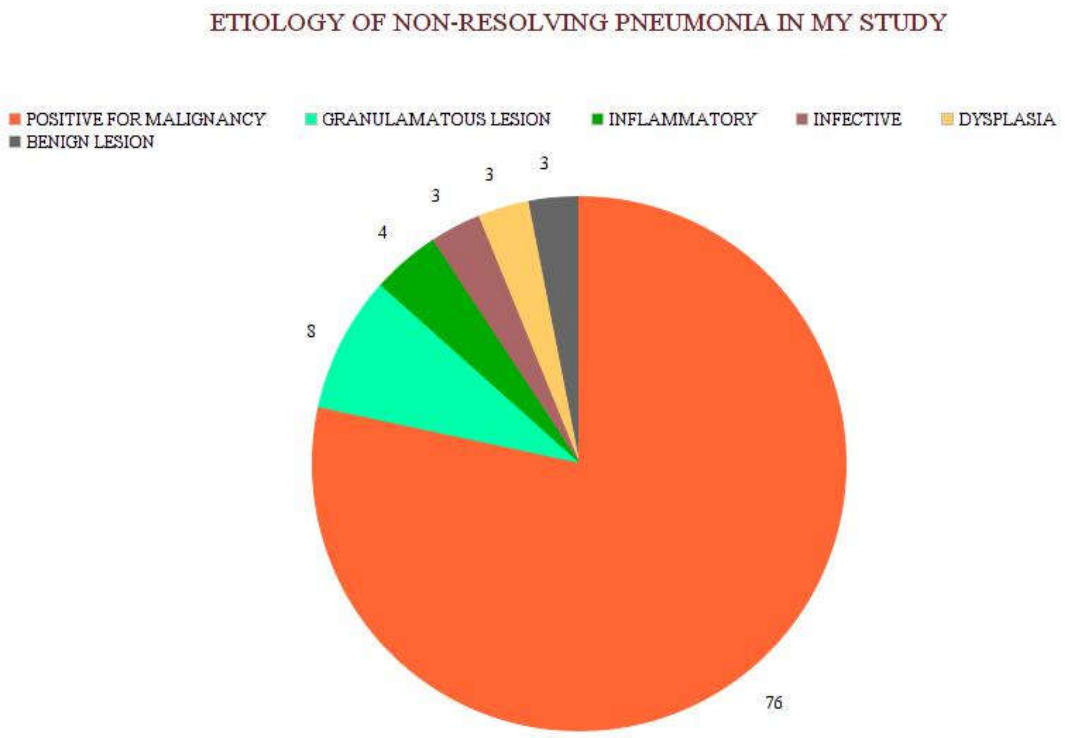
YIELD OBTAINED	YIELD NOT OBTAINED
59 (95.2%)	3 (4.8%)

DISTRIBUTION OF CASES

Incidence Of smear positive for malignancy was 76%(n=47).incidence of granulomatous lesion was 8% (n=5).incidence of inflammatory smear was 4%(n=3).no of smear with infective material was 3%(n=2).incidence of dysplasia and benign lesions were 3%(n=2),4%(n=3).majority of lesions diagnosed were carcinoma in my study followed by granulomatous lesions(Table 4).

Table 4: Etiology of non resolving pneumonia in my study

Diagnosis	Number	Percentage
tive for malignancy	47	76%
nulomatous Lesion	5	8%
mmatory	3	4%
ctive	2	3%
plasia	2	3%
ign Lesion	3	4%
l	62	100%

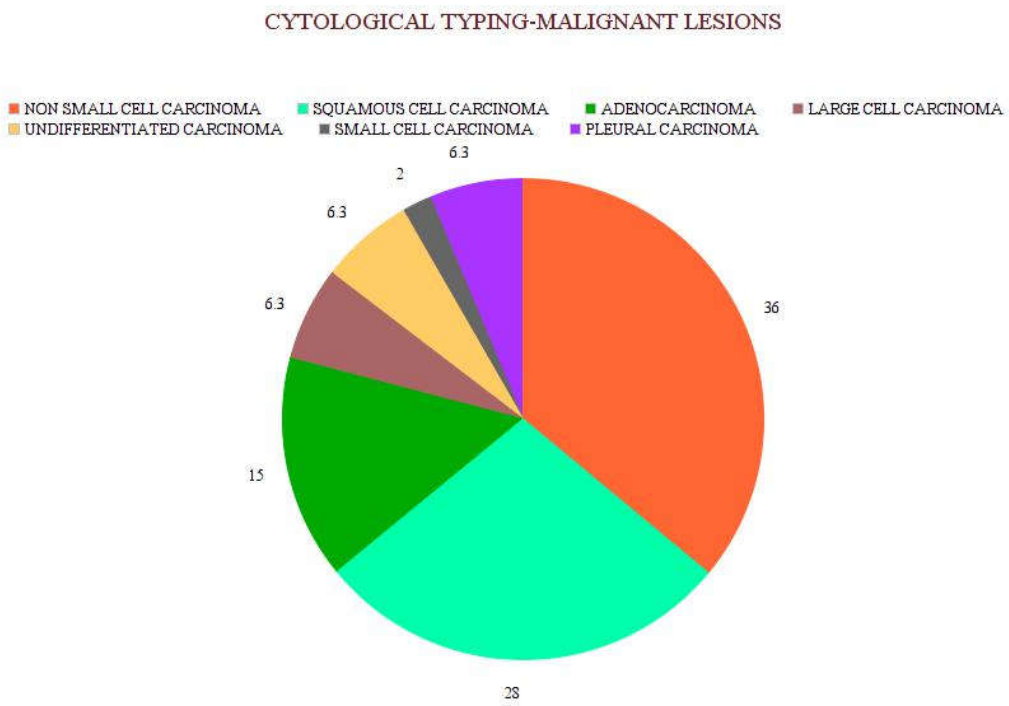


CYTOLOGICAL TYPING OF MALIGNANT LESIONS :

Majority of patients with non resolving pneumonia in my study were diagnosed to have malignancy by USG guided FNAC. Most common malignancy diagnosed was non small cell carcinoma. Incidence was 36%(n=17)(table 5). Next in this series was squamous cell carcinoma with the incidence of 28%(n=13). Adenocarcinoma was seen in 15% (n=7) of cases.6.3% (n=3) of cases were large cell carcinoma. Incidence of undifferentiated carcinoma and pleural tumours were 6. 3%(n=3) respectively. Least common malignancy diagnosed in my study was small cell carcinoma 2%(n=1).

Table 5 :Cytological types of malignancy in my study

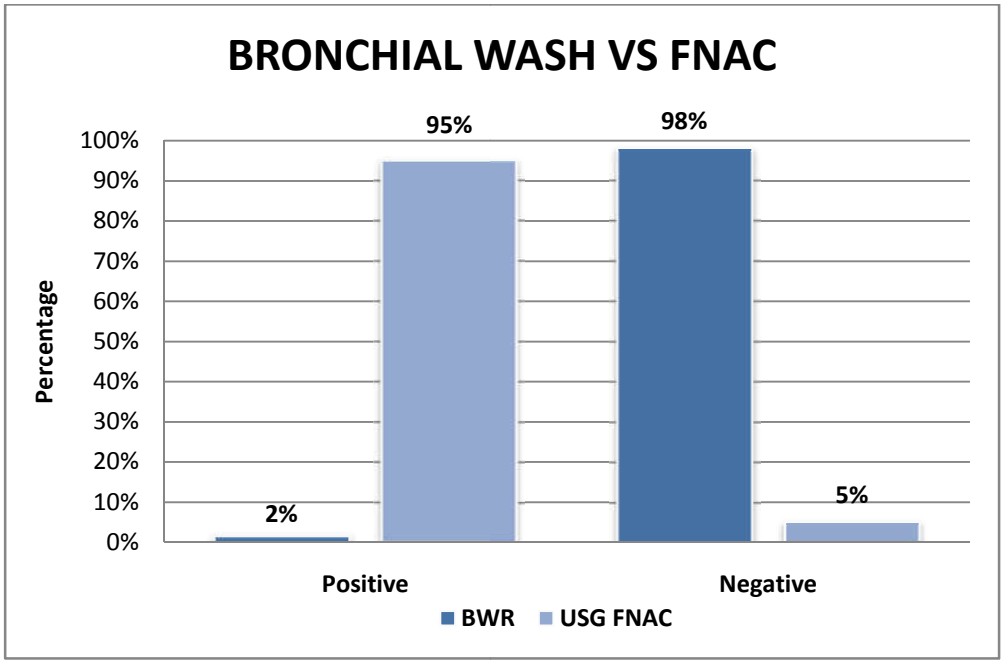
NG	MBER	CENTAGE
small cell carcinoma	17	36%
amous cell carcinoma	13	28%
nocarcinoma	7	15%
e cell Carcinoma	3	6.3%
ifferentiated carcinoma	3	6.3%
ll cell Carcinoma	1	2%
ral carcinoma	3	6.3%
l	47	100%



YIELD OF USG GUIDED FNAC VS YIELD OF BRONCHIAL WASH RESULTS:

All patients with non resolving consolidation in my study also underwent bronchoscopy which was routinely done to find out the etiology in our department of chest medicine. Bronchial wash and cytology were also taken and analyzed to find out microbial growth, Acid fast bacillus staining and cytological analysis. In 62 cases yield of bronchoscopy was meager 2% (n=1) when compared to USG guided FNAC which yielded 95%(N=59)(Figure 26).USG guided FNAC was not helpful in 5%(n=3) cases in contrast to bronchial wash which was not at all useful in majority of cases 98%(n=61).this was probably due to the fact that lesions were more peripherally placed than in center of lung parenchyma.

Figure 26:Comparison Of FNAC And Bronchial Wash



TISTICAL ANALYSIS :

ensitivity of test means ability of a test to find out patients with the disease. stivity of ideal diagnostic test should be 100%.but this is not always possible due nany factors associated with standardization of instrument and person who orm the test, sample collected.

In my study after collection of results obtained from USG guided C,SENSITIVITY OF TEST was 100% with signicant p value of less than 0.0001% ording to McNemar Test which statistically non significant. **McNemar's test** is a

istical **method** used to compare two categorical variables. In my study 2 variables e results obtained in USG guided FNAC and BRONCHIAL WASH ANALYSIS. Nemar test is a 2 × 2 contingency tables with matched pairs of subjects, to ermine whether the row and column marginal frequencies are equal.

Positive **predictive value(NPV) which means** the probability that patient with **sitive** test truly have the disease was 93% which highlights the diagnostic ability USG guided FNAC. From statistical analysis of my data ,it was clearly shown that e is SIGNIFICANT diagnostic accuracy and effectiveness of ULTRASOUND guided C IN NON RESOLVING PENUMONIA

TISTICAL (Table 6):

		BRONCHIAL WASH		
		Positive	Negative	
NAC	Positive	1	57	
	egative	0	4	

Nemar Test

lue

001

SENSITIVITY (Table 7) :

Sensitivity	Specificity	PPV	V
100%	7%	2%	)%

sitivity of my study was 100%

FPR	0.934426	e positive rate
FNR	0	e negative

False positive rate which means A test **result** appears **positive** when it should be.In my study false positive rate is 0.93 which is ideal for a DIAGNOSTIC test

INCIDENCE OF COMPLICATION:

Patient who underwent ULTRASOUND GUIDED FNAC were requested for chest xray. Out of 62 patients one patient had radiographic evidence of loculated pneumothorax,(table 7) but the patients was clinically stable. Patient was observed for a week in the ward and treated without ICD AND DISCHARGED.NO PATIENTS had bleeding complication. There was no other complication such as hemoptysis and bleeding.

	NO	YES
PNEUMOTHORAX	61 (98.4%)	1 (1.6%)

INCIDENCE OF PNEUMOTHORAX(Figure : 27)

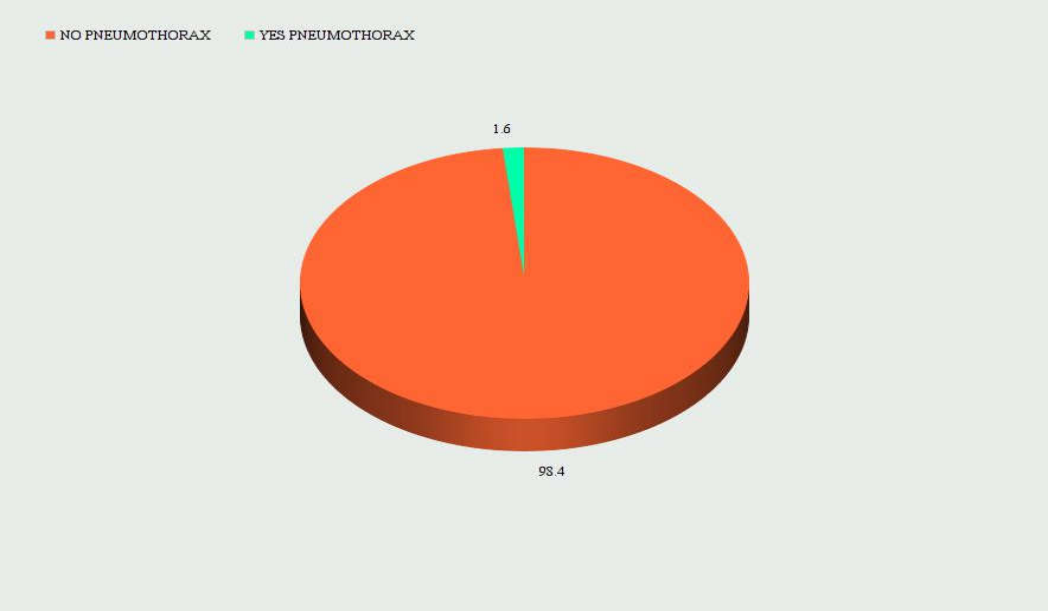


Figure 27: Incidence Of Pneumothorax

DISCUSSION

DISCUSSION:

Ultrasound is a easy to handle,reliable ,radiation and electromagnetic radiation free diagnostic test. Sensitivity of USG guided FNAC in **my study** population was **100** percent. This is comparable to **Qian-jing hu** et al's bivariate meta analysis of 9 different study series of ultrasound guided FNAC which came to conclusion that sensitivity was **97%.sensitivity of USG guided FNAC in nahar begum et al was 91.2%.In indian pretext shivani et al study on USG guided FNAC showed a diagnostic efficacy of 91.3% which is comparable to my study(figure 28).**

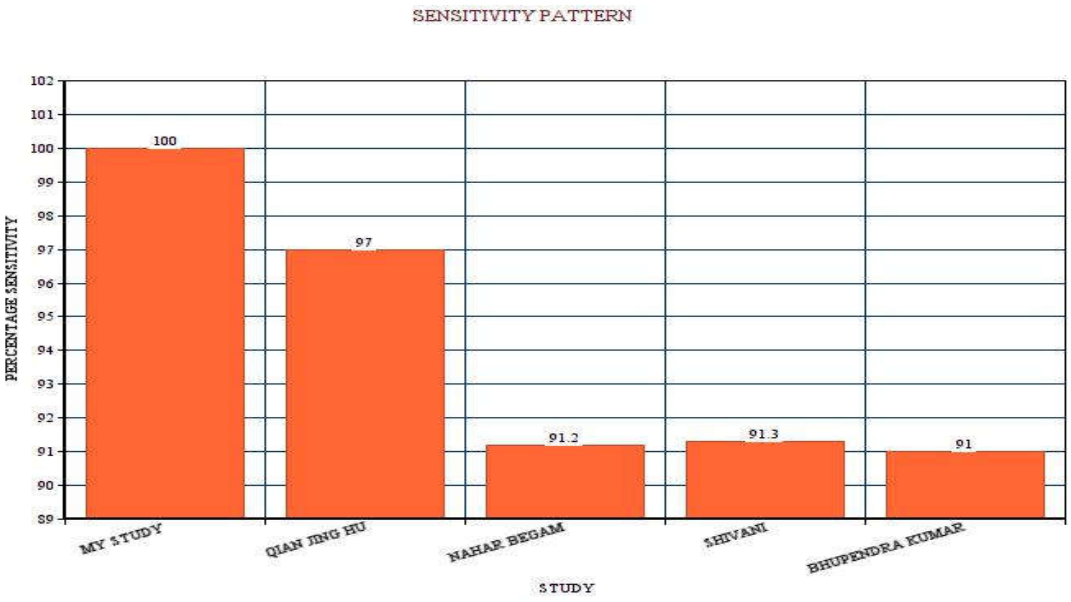


Figure 28: comparison of sensitivity of all studies

Diagnostic accuracy of ultrasound guided FNAC of my study was 95.2% whereas diagnostic accuracy of nahar begum et al study done at Rajsahi was 93.8%. My study showed diagnostic accuracy compared to Mohammed et al (2006) which had 97% accuracy, Gouliamos et al(2000) study group which had a diagnostic accuracy of 98.4% and Stanley et al study group with 96.6%(figure 29).

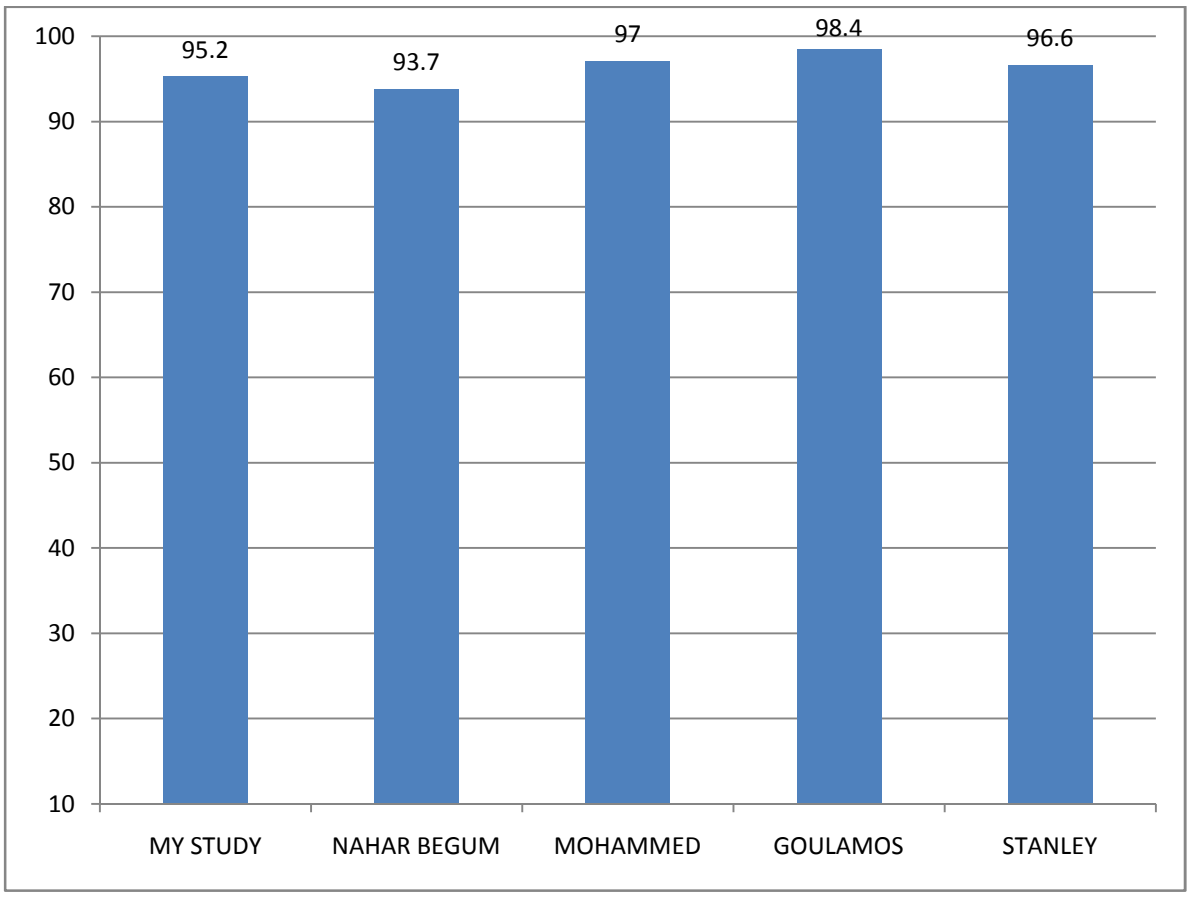


Figure 29:comparison of diagnostic accuracy

Complication rate in nahar begum et al was 6.6% for pneumothorax. Incidence of pneumothorax in Stanley et al, mohammed et al,gouliamos et al were 29%,1.1%,3.1% respectively. In my study incidence of pneumothorax was 1.6%(n=1).this was comparable to the above studies(figure 30).

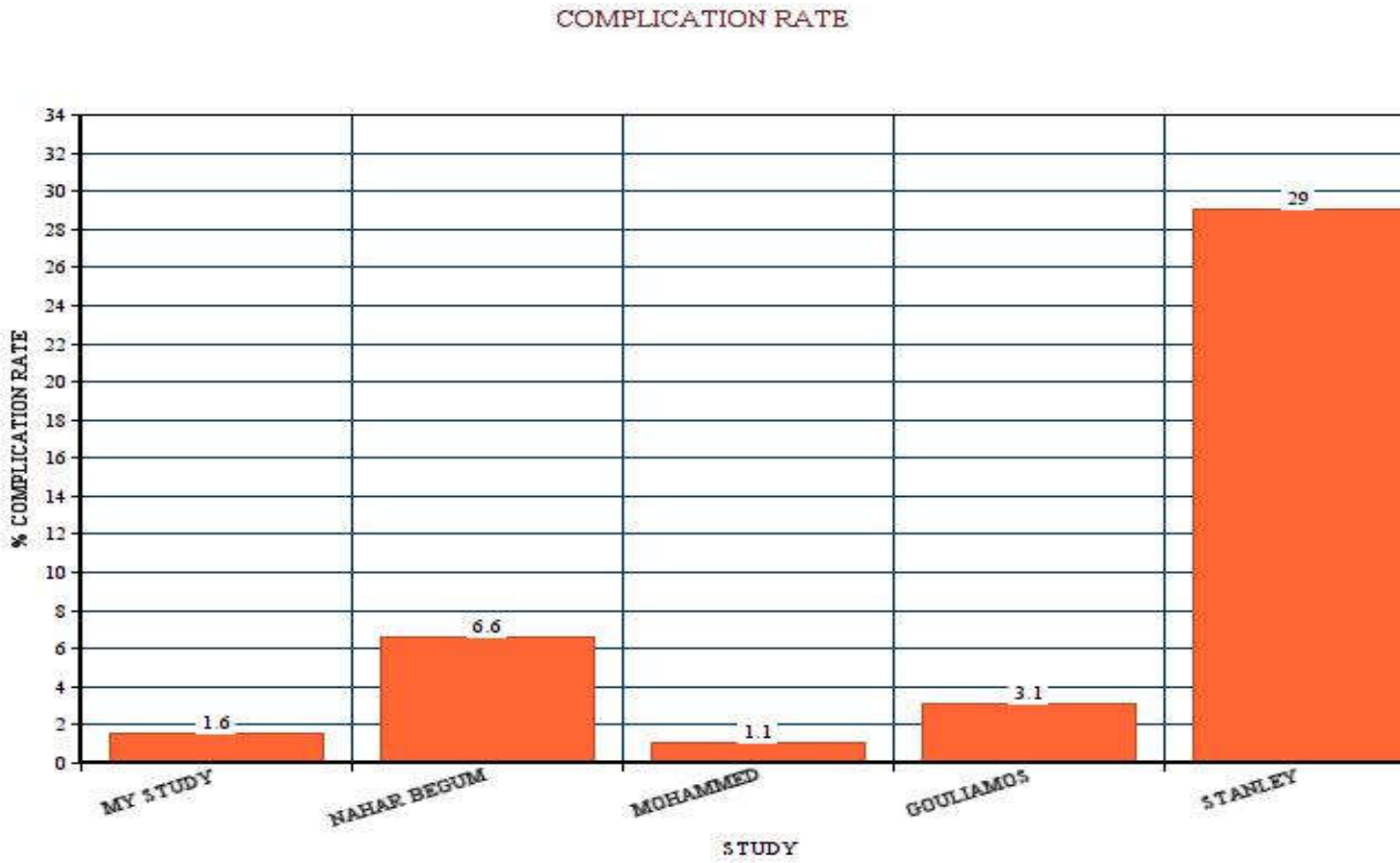


Figure 30: Comparison Of Complication Rate

There was **no incidence of hemoptysis, bleeding complications, death due to FNAC in my study** as compared to Nahar Begum et al where one patient died due FNAC,3.8% patients

had hemoptysis and 2.8% patients had haemorrhage.in Stanley et al study group incidence of hemoptysis was 1.1%.5.4% patients in Mohammed et al study group had hemoptysis. In Gouliamos et al study group 1.6% had bleeding complication.

ETIOLOGY OF NON RESOLVING PNEUMONIA IN MY STUDY

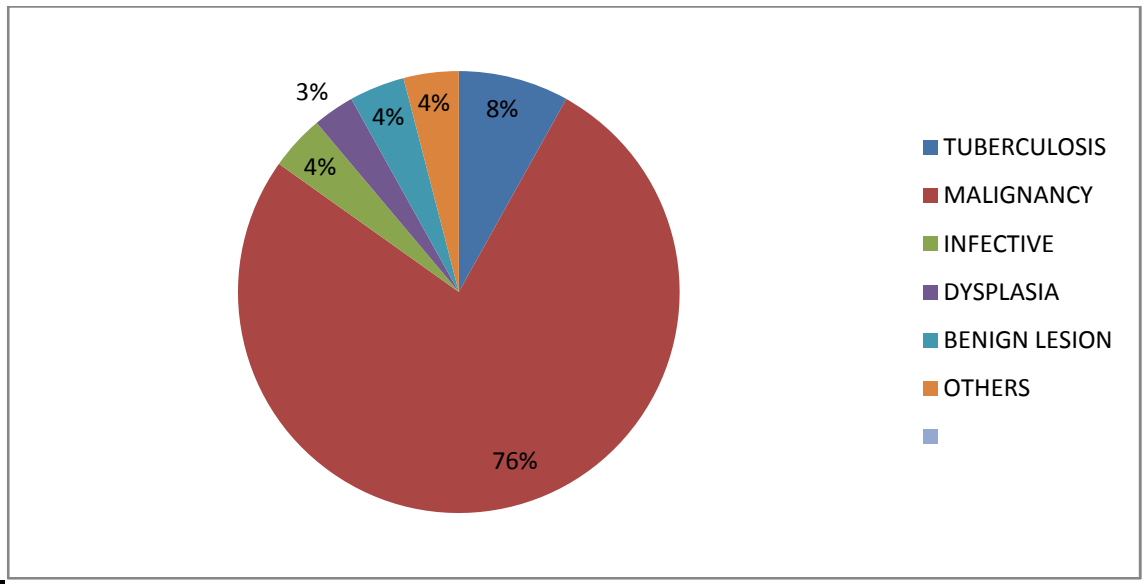


FIGURE 31:COMMON ETIOLOGIES OF NON RESOLVING PNEUMONIA IN MY STUDY

Most common cause of non resolving pneumonia in my study group was lung malignancy 76% followed by granulomatous lesion probably tuberculosis 8%. Dysplasia, infective pathogens and benign lesion such thymoma and schwanoma contributed to 4% each respectively(figure 31). Since our institution is tertiary care hospital, referral cases which were managed by initially by general physicians with no resolution of pulmonary consolidation even with ATT and empirical antibiotic probably were referred to us. This could

be reason for high incidence of malignancy. More over in our part of the world, smoking is an epidemic making probability of getting malignancy high.

ETIOLOGY OF NON RESOLVING PNEUMONIA IN JEYAPRAKASH STUDY

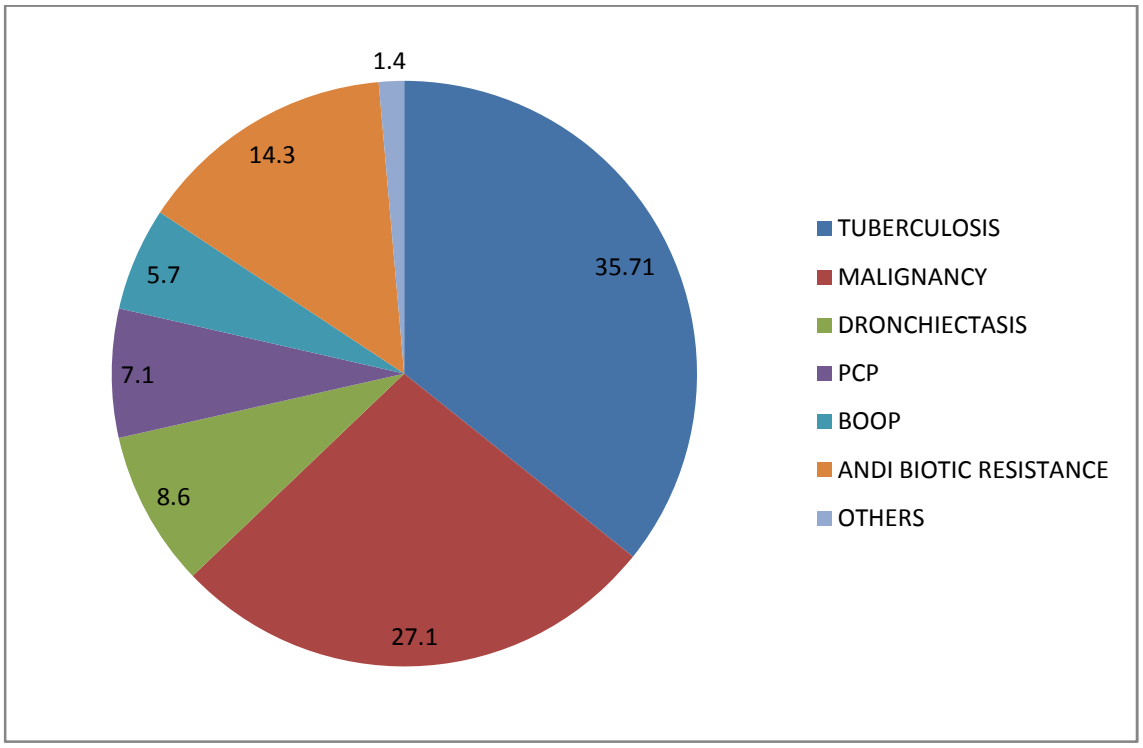
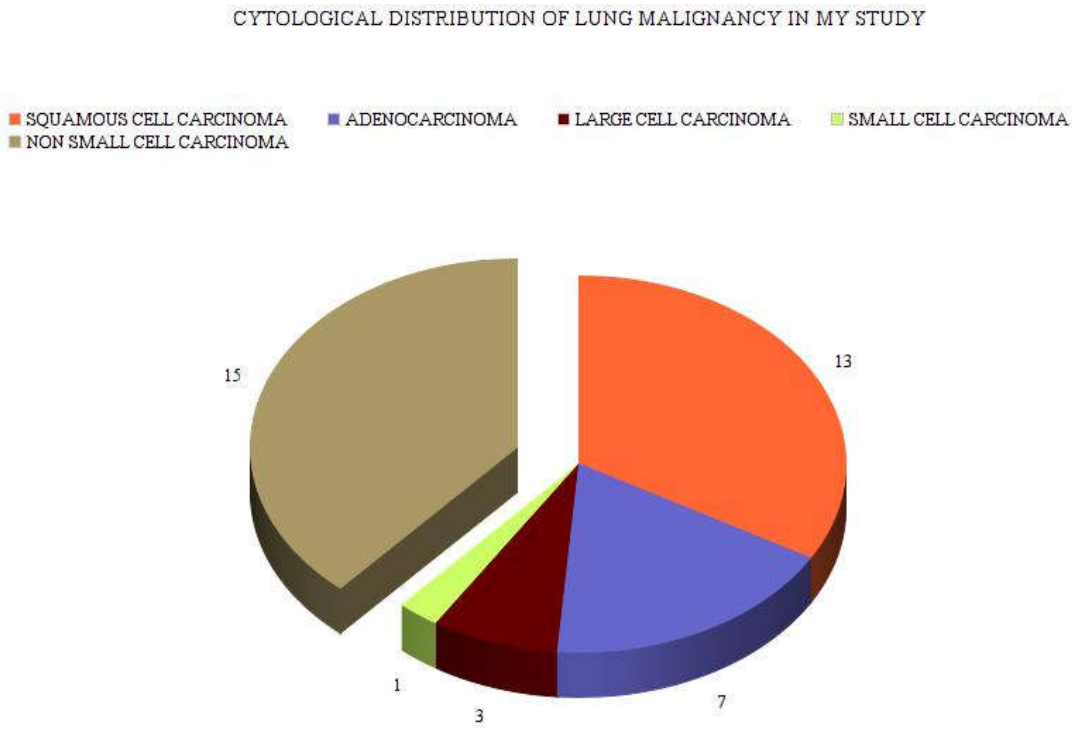


FIGURE 32: ETIOLOGIES OF NON RESOLVING CONSOLIDATION IN JEYAPRAKASH STUDY

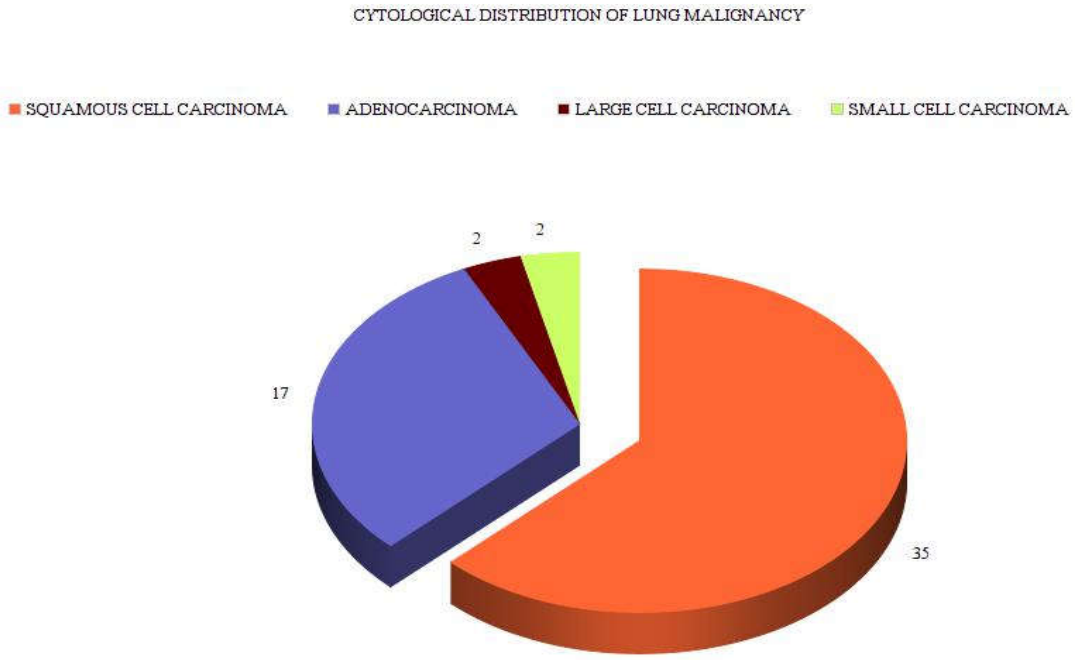
In contrast to our study, most common etiology of non resolving pneumonia in Jeyaprakash et al study in Trivandrum medical college which is 400 kms from our institution was tuberculosis (35.7%) and malignancy (27%) reason for this disparity can be attributed to diabetes endemic in that region which contributes to tuberculosis.

In chest hospital Vishakpattnam, Andra Pradesh ,out of 30 cases diagnosed with non resolving pneumonia,10 were diagnosed to have tuberculosis out of 4 were diagnosed by FNAC of the lesion either by CT or USG guided. In 9 cases diagnosed with malignancy ,5 cases were diagnosed with FNAC establishing importance of image guided FNAC.

Analysing the cytological distribution of malignancy In my study and Hayder et al study whose study had relatively similar incidence of lung malignancy(57 out Of 75 Cases) in USG Guided FNAC, non small cell Carcinoma(N=15) Was Predominant In my study compared to squamous cell carcinoma(n=35) in hyder et al study group. Incidence of adenocarcinoma was more in hyder et al group. incidence of small cell carcinoma was comparable in both studies (Figure 33).



In Hyder et al Study Group(figure 33)



CONCLUSION

TO CONCLUDE MY STUDY,FOLLOWING FINDINGS WERE OBSERVED:

1. SENSITIVITY OF USG GUDED FNAC IN DIAGNOSING NON RESOLVING PNEUMONIA WAS 100% WHICH MAKES USG GUIDED FNAC AS IDEAL DIAGNOSTIC INVESTIGATION

2. COMPLICATION RATE FOR USG GUIDED FNAC WAS 1.6% WHICH WAS VERY NEGLIBLE COMPARING TO TRANSTHORACIC BIOPSY WHICH IS THE GOLD STANDARD TEST

3. FOR NON RESOLVING CONSOLIDATION SITUATED ADJACENT TO CHEST WALL USG GUIDED FNAC IS INVESTIGATION OF CHOICE THAN BRONCHOSCOPY

4. USG GUIDED FNAC CAN BE DONE BY PULMONOLOGIST AND TREATING PHYSCIAN WITH MINIMAL TRAINING WITHOUT THE COMPLICATION IN DAY CARE CLINICS.

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